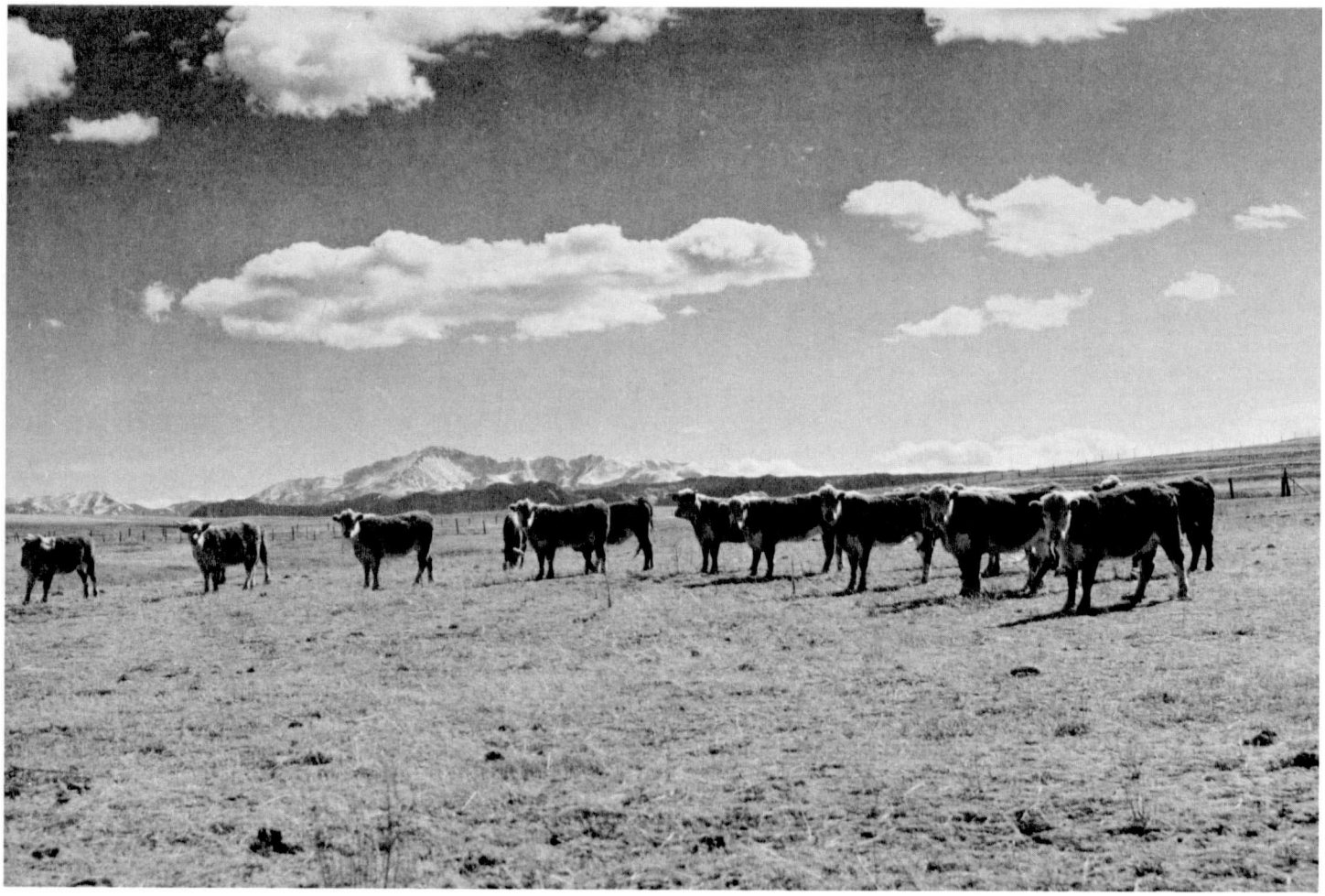
SOIL SURVEY OF

Castle Rock Area, Colorado



U. S. Department of Agriculture
Soil Conservation Service
In cooperation with
Colorado Agricultural
Experiment Station

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Major fieldwork for this soil survey was done in the period 1962-65. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the Area in 1965. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Douglas County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D. C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for agriculture, industry, and recreation.

Locating Soils

All the soils of the Castle Rock Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the Area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

Foresters and others can refer to the section "Woodland," where suitability of the soils of the Area for trees is discussed.

Game managers, sportsmen, and others can find information about soils and wildlife in the sections "Recreation" and "Wildlife."

Ranchers and others can find, under "Range" groupings of the soils according to their suitability for range, and descriptions of the vegetation that grows on each range site.

Community planners and others can read, in the section "Town and Country Planning," explanation of the way soil properties affect the choice of sites for nonindustrial buildings and for recreation.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers to the Castle Rock Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the Area given in the section "General Nature of the Area."

Cover picture: Soils of the Brussett-Jarre association in the southern part of the Castle Rock Area. About 75 percent of the Area is range. In the background is Pikes Peak.

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BY LYNN S. LARSEN, SOIL CONSERVATION SERVICE

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE COLORADO AGRICULTURAL EXPERIMENT STATION

THE CASTLE ROCK AREA is located in Douglas County in the north-central part of Colorado (fig. 1). The Area is in the South Platte watershed. Castle Rock, the county seat of Douglas County, is in about the center of the survey area.

The Area consists of that part of Douglas County excluding the area in the Pike National Forest in the western part and, at the request of the owner, one large ranch on the northern boundary. The Area covers about 360,620 acres. About 11,000 acres is irrigated, about 49,029 acres is dryfarmed, about 36,000 acres is private woodland, and the rest is in pasture and range.

Many types of agricultural enterprises are in the Area. Some of the main enterprises are raising feeder cattle and purebred breeding cattle, growing wheat, and dairying. Registered quarter horses and thoroughbred horses are raised. Urbanization is moving into the Area from nearby metropolitan areas.

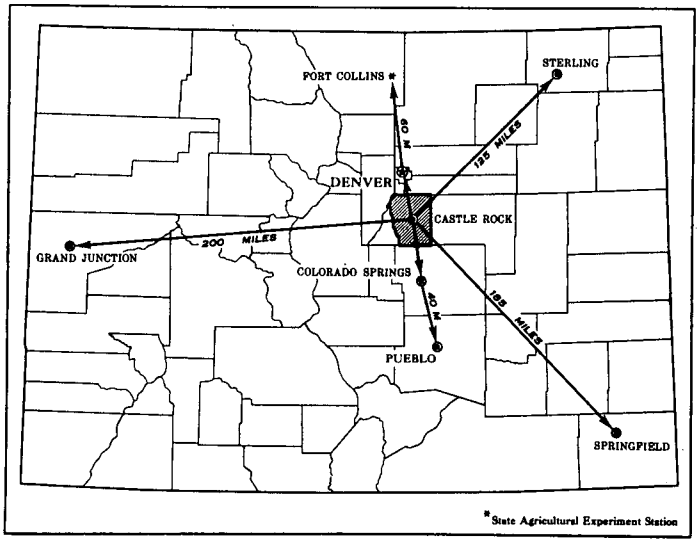


Figure 1.--Location of Castle Rock Area in Colorado.

HOW THIS SURVEY WAS MADE

Soil scientists made this survey to learn what kinds of soil are in the Castle Rock Area, where they are located, and how they can be used. The soil scientists went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Bresser and Denver, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Bresser sandy loam, 1 to 3 percent slopes, is one of several phases within the Bresser series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one

series. Three such kinds of mapping units are shown on the soil map of the Castle Rock Area: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Kettle-Falcon complex, 9 to 65 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extend of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Stapleton-Bresser association is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and". Pring and Kippen gravelly sandy loam, 1 to 25 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Sandy alluvial land is a land type in the Castle Rock Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

GENERAL SOIL MAP

The general soil map at the back of this publication shows, in color, the soil associations in the Castle Rock Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an Area, who want to compare different parts of an Area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eight soil associations in the Castle Rock Area are described in the following pages.

1. Loamy Alluvial Land-Sampson Association

Deep, nearly level to gently sloping, loamy and sandy soils on flood plains and terraces

This association is along the major streams of the survey area. The vegetation is mainly grass, but trees grow in places. Elevations range from 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 48° to 50° F., and the growing season is 120 to 135 days.

This association makes up about 6 percent of the Area. It is about 25 percent Loamy alluvial land and 20 percent Sampson soils. The rest is Loamy wet alluvial land, Sandy wet alluvial land, Sandy alluvial land, and Bresser soils.

Loamy alluvial land consists of deep, dark-colored, loamy soils in swales and other low-lying areas.

Sampson soils are on the higher lying areas. They are deep clay loams that have slightly stratified underlying material.

Flooding is a hazard in this association, especially in the lower lying areas. Gullies are common in areas of alluvial land (pl. I, top).

This association is used mostly for grazing livestock. The higher lying areas are suitable for cultivation, especially where irrigation water is available. Most water for irrigation is pumped from wells. Alfalfa, irrigated pasture grasses, and corn for silage are the main crops. Wheat is grown where irrigation water is not available. Urbanization from the Denver metropolitan area is moving into the higher lying areas along Cherry Creek. This association is suited to wildife habitat and recreational facilities.

2. Fondis-Kutch Association

Deep and moderately deep, gently sloping to moderately steep, loamy soils on uplands

This association is on mesa tops and uplands in the northern part of the survey area. The vegetation is mainly grass and Gambel oak (pl. I, bottom). Elevations range from 5,500 to 6,800 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 48° to 50° F., and the growing season is 120 to 135 days.

This association makes up about 21 percent of the Area. It is about 55 percent Fondis soils and about 15 percent Kutch soils. Satanta, Newlin, Manzanola, Renohill, and Buick soils make up the remaining 30 percent.

Fondis soils are on the higher lying areas. They are deep and have a clay subsoil that is underlain by a calcareous older soil.

Kutch soils generally are below Fondis soils in the landscape. They have a clay subsoil that is underlain by shale or sandstone between depths of 20 and 40 inches.

About three-fourths of this association is used for grazing livestock. The rest is cultivated and used to grow small grain, mainly wheat. Most of the cultivated areas are on slopes of less than 9 percent. Summer fallow is needed to produce crops. Control of soil blowing and water erosion is necessary in cultivated areas. Urbanization is moving into this association.

3. Bresser-Newlin-Stapleton Association

Deep, gently sloping to moderately steep, sandy and gravelly soils on uplands

This association is on uplands in the northern, warmer part of the survey area. The vegetation is mainly grass, Gambel oak, and mountain-mahogany on the gravelly and the steep cobbly areas and ponderosa pine on some areas of Stapleton, Newlin, and Kutch soils. Elevations range from 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 51° F., and the growing season is 120 to 135 days.

This association makes up about 27 percent of the Area. It is about 30 percent Bresser soils, about 25 percent Newlin soils, and about 10 percent Stapleton soils. Truckton, Blakeland, and Kutch soils and Hilly gravelly land and Stony steep land make up the remaining 35 percent. Rock outcrop, cobblestones, and rocks are common in this association.

Bresser soils are on terraces and uplands. They are deep, gently sloping to moderately steep sandy loams.

Newlin soils are on uplands and side slopes. They are moderately deep, rolling to moderately steep sandy loams or loamy sands that developed over very gravelly sand.

Stapleton soils are on uplands. They are moderately deep, sloping to steep sandy loams that formed in alluvium derived from weathered arkosic sedimentary rock.

This association is used mostly for grazing livestock, but a few areas of Bresser and Truckton soils are cultivated where slopes are less than 9 percent. Small grain, mainly wheat, is the major crop. Urbanization is taking place in the wooded areas of the association. Most of these soils have good bearing strength for foundations.

4. Razor-Denver Association

Deep and moderately deep, gently sloping to steep, clayey soils on uplands

This association is on uplands in the northwestern part of the Area. The vegetation is mainly grass. Elevations range from 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the growing season is 120 to 135 days.

This association makes up about 2 percent of the Area. It is about 60 percent Razor soils and about 30 percent Denver soils. The rest is Heldt and Fondis soils.

Razor soils are moderately deep, sloping to steep clays that developed over shale on uplands.

Denver soils are deep, moderately steep, calcareous soils that formed in clayey material on uplands.

The soils of this association have a slow rate of water intake. Where the cover is poor, water erosion is a hazard. The soils slip when wet and form catsteps.

This association is used mostly for grazing livestock. It lacks adequate cover and water for most wildlife, and it has a poor potential for homesites because of the high shrink-swell potential.

5. Peyton-Kettle-Crowfoot Association

Deep, gently sloping to moderately steep, sandy soils on uplands

This association is hills and buttes on uplands in the southern part of the Area. The vegetation is

mainly mid and tall grasses, but about 20 percent of the association is covered with brush, mainly Gambel oak, and another 15 percent has ponderosa pine. The wildlife is mainly deer, antelope, rabbit, and bear. Elevations range from 6,600 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the growing season is 115 to 125 days.

This association makes up about 28 percent of the Area. It is about 25 percent Peyton soils, about 15 percent Kettle soils, and about 15 percent Crowfoot soils. The rest is Pring, Kippen, Cruckton, Falcon, and Coni soils and Stony steep land, cold, and Loamy wet alluvial land.

Peyton soils are deep sandy loams or loamy sands that have a sandy clay loam subsoil.

Kettle soils are sandy and have bands of sandy clay loam in the subsoil.

Crowfoot soils are deep sandy loams or loamy sands that have a clay loam and sandy clay loam subsoil.

In this association water erosion is the main hazard. Soil slippage is common on the steeper slopes (plate II, top).

This association is used mostly for grazing livestock and for wildlife habitat. A few areas are cultivated and used to grow winter wheat and oats, but frost late in spring limits grain production. Many fields are reseeded to smooth brome and intermediate wheatgrass. Most areas of this association are suited for homesite construction.

6. Brussett-Jarre Association

Deep, gently sloping to steep, loamy soils on tablelands

This association is on tablelands in the southern, cooler part of the Area. The vegetation is mainly western wheatgrass, junegrass, blue grama, mountain muhly, and Gambel oak. Elevations range from 6,600 to 7,800 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the growing season is 115 to 125 days.

This association makes up about 6 percent of the Area. It is about 60 percent Brussett soils and about 20 percent Jarre soils. Tinytown, Cheeseman, Coni, Peyton, and Pring soils and Loamy wet alluvial land make up the rest.

The Brussett soils are on tablelands. They are nearly level to gently sloping and have a loam surface layer and clay loam subsoil.

The Jarre are strongly sloping to moderately steep soils on upland side slopes and small knobs. They have a loam surface layer and a gravelly loam and gravelly sandy loam subsoil.

This association is used mostly for grazing livestock. A few areas are dryfarmed and used to grow winter wheat and oats, but frosts late in spring limit grain production.

In this association water erosion is the main hazard, and during spring, runoff from snowmelt can cause excessive water erosion where the soil is left bare (plate II, bottom). This association is suited to urban development.

7. Garber-Kassler-Rockland Association

Deep to shallow, gently sloping to steep, sandy and gravelly soils on terraces, fans, and valley side slopes

This association is on foothills along the front range in the western part of the Area. The vegetation is mainly a mixture of native grasses, ponderosa pine, Gambel oak, mountain-mahogany, and squawbush. Elevations range from 6,200 to 8,000 feet. Annual precipitation is 15 to 21 inches. Mean annual soil temperature is 44° to 48° F., and the growing season is less than 125 days.

This association makes up about 6 percent of the Area. It is about 13 percent Garber soils, about 13 percent Kassler soils, and about 10 percent Rockland. Soils of 10 different series are in small, irregularly shaped areas and make up the rest of the association.

The Garber soils are on alluvial fans and valley side slopes. They are deep, sloping to steep, dark-colored very gravelly sandy loams.

The Kassler soils are on terraces. They are deep, gently sloping, dark-colored gravelly sandy loams and very gravelly loamy sands.

Rock land is common in the Perrypark area. It stands in long, narrow bands in the form of cliffs (plate III, top) or as monuments and sentinels. It is made up of shallow and very shallow soils and gray to red and pink sandstone and limestone that contains alabaster beds in places.

Runoff from higher lying areas and rock outcrop in this association subject the drainageways and foot slopes to water erosion.

This association is used for grazing livestock. It is excellent habitat for wildlife and has the most wildlife of the Area. It has the most spectacular scenery of the Area and is well suited to park and recreation sites. The association is popular for homesites, but the soils have slight to severe limitations.

8. Juget-Rock Land Association

Shallow, steep, gravelly soils and Rock land in mountainous areas

This association is in the mountainous area on the western side of the Area adjacent to Pike National Forest. About two-thirds of the association has a forest cover that consists of a mixture of ponderosa pine, Douglas-fir, and white fir, and about one-third has a brush and grass cover. The north-facing slopes have more trees than the south-facing slopes. Elevations range from 6,300 to more than 8,000 feet. Annual precipitation is 18 to 22 inches. Mean annual soil temperature is 42° to 46° F., and the growing season is less than 120 days.

This association makes up about 4 percent of the Area. It is about 65 percent Juget soils and about 15 percent Rock land. Westcreek and Garber soils and a moderately deep soil with a clay and clay loam subsoil make up the remaining 20 percent.

Juget soils are in the mountainous part of the Area. They are steep, very gravelly sandy loams and loamy sands that are shallow over granite bedrock.

Rock outcrop is made up of barren cliffs of granite.

Water erosion is a moderate to severe hazard in this association. Soil slippage is common. Gullies form easily.

This association is not suited to cultivation. It is used for grazing livestock, wildlife habitat, recreation, Christmas trees, and lumber for fence poles.

DESCRIPTIONS OF THE SOILS

This section describes the soil series and mapping units in the Castle Rock Area. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a dry soil.

As mentioned in the section "How This Survey Was Made", not all mapping units are of a soil series Rock land, for example, does not belong to a soil series, but nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and range site in which the mapping unit has been placed. The page for the description of each capability unit and range site can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (5) 1/.

1/ Underscored numbers in parentheses refer to Literature Cited, p. 121.

Blakeland Series

The Blakeland series consists of well-drained soils that formed in sand deposited by wind and water on uplands and alluvial fans. These soils are mostly on the east side of major drainageways in the northern part of the Area. Slopes are 1 to 15 percent. The vegetation is mainly tall grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile, the surface layer is dark grayish-brown light sandy loam about 13 inches thick. The next layer is brown loamy coarse sand about 11 inches thick. The underlying material is stratified light yellowish-brown coarse loamy sand to sand. In places, hard arkosic shale is below a depth of 40 inches.

Blakeland soils have rapid permeability. Available water capacity is low. Roots can penetrate to a depth of 40 inches or more.

Most areas of Blakeland soils are in native grasses and are used for grazing cattle and horses. Some areas are irrigated, and others are dryfarmed, although the soils are droughty. These soils are suited to urban development.

Representative profile of Blakeland sandy loam, in native pasture half a mile south and 300 feet east of the northwest corner of sec. 7, T. 8 S., R. 65 W.:

A11--0 to 6 inches, dark grayish-brown (10YR 4/2) light sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard, very friable; pH 6.8; clear, smooth boundary.

A12--6 to 13 inches, dark grayish-brown (10YR 4/2) light sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium to coarse, subangular blocky structure; hard, very friable; pH 6.8; clear, wavy boundary.

AC--13 to 24 inches, brown (10YR 5/3) loamy coarse sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; very hard, very friable; pH 6.8; gradual, smooth boundary.

C--24 to 60 inches, light yellowish-brown (2.5Y 6/3) stratified coarse loamy sand to sand, light

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Blakeland sandy loam, 1 to 15 percent slopes	1,330	0.4	Kutch sandy loam, 5 to 20 percent slopes	4,140	1.2
Blakeland-Orsa association	2,550	.7	Kutch clay loam, 4 to 8 percent slopes	3,310	.9
Bresser sandy loam, 1 to 3 percent slopes	4,030	1.1	Kutch clay loam, 8 to 20 percent slopes	1,240	.3
Bresser sandy loam, 3 to 9 percent slopes	6,200	1.7	Kutch-Newlin-Stapleton complex, 8 to 40 percent slopes	6,160	1.7
Bresser-Louviers complex, 7 to 30 percent slopes	1,500	.4	Larkson fine sandy loam, 3 to 9 percent slopes	200	.1
Bresser-Truckton sandy loams, 5 to 25 percent slopes	15,000	4.2	Loamy alluvial land	5,660	1.6
Bresser and Truckton soils, 3 to 12 percent slopes, eroded	1,730	.5	Loamy alluvial land, dark surface	850	.2
Brussett loam, 1 to 3 percent slopes	2,190	.6	Loamy wet alluvial land	5,400	1.5
Brussett loam, 3 to 9 percent slopes	8,650	2.4	Manzanola clay loam	2,250	.6
Buick-Satanta loams, 3 to 9 percent slopes	3,100	.9	Newlin gravelly sandy loam, 8 to 30 percent slopes	11,910	3.3
Coni rocky loam, 3 to 100 percent slopes	9,900	2.8	Newlin-Satanta complex, 5 to 20 percent slopes	15,410	4.3
Crowfoot-Tomah sandy loams, 5 to 25 percent slopes	8,280	2.3	Perrypark sandy loam, 3 to 20 percent slopes	760	.2
Cruckton sandy loam, 1 to 9 percent slopes	2,640	.7	Peyton sandy loam, 1 to 3 percent slopes	870	.2
Cruckton-Peyton sandy loams, 7 to 20 percent slopes	1,190	.3	Peyton sandy loam, 3 to 9 percent slopes	5,430	1.5
Denver clay loam, 5 to 12 percent slopes	1,370	.4	Peyton sandy loam, wet, 1 to 5 percent slopes	720	.2
Englewood clay loam	2,540	.7	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes	30,810	8.5
Fondis clay loam, 1 to 3 percent slopes	6,750	1.9	Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded	2,030	.6
Fondis clay loam, 3 to 9 percent slopes	20,910	5.8	Plome loamy sand, 5 to 25 percent slopes	880	.2
Fondis-Kutch association	26,510	7.3	Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes	4,440	1.2
Garber gravelly sandy loam, 5 to 30 percent slopes	1,860	.5	Razor clay, 3 to 25 percent slopes	3,980	1.1
Gove sandy loam, 5 to 20 percent slopes	1,470	.4	Rednun loam, 3 to 10 percent slopes	680	.2
Gove-Shale outcrop complex, 5 to 65 percent slopes	1,690	.5	Rednun-Redridge complex, 8 to 40 percent slopes	2,410	.7
Heldt clay	280	.1	Redridge-Chaseville gravelly sandy loams, 10 to 70 percent slopes	3,010	.8
Hilly gravelly land	7,420	2.1	Redtom-Lonetree complex, 5 to 25 percent slopes	2,410	.7
Jarre-Brussett association	9,560	2.7	Renohill-Buick complex, 5 to 25 percent slopes	6,000	1.7
Juget rocky complex, 20 to 65 percent slopes	9,070	2.5	Renohill-Manzanola clay loams, 3 to 20 percent slopes	2,420	.7
Juget very rocky complex, 20 to 65 percent slopes	4,780	1.3	Renohill sandy loam, reddish variant, 5 to 20 percent slopes	120	(1/)
Kassler gravelly sandy loam	1,570	.4			
Kettle loamy sand, 5 to 25 percent slopes	6,780	1.9			
Kettle-Falcon complex, 9 to 65 percent slopes	5,120	1.4			
Kippen loamy sand, 1 to 20 percent slopes	7,920	2.2			
Kippen and Pring soils, 1 to 12 percent slopes, eroded	1,670	.5			

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Rockland-Lonetree complex, 10 to 100 percent slopes	2,530	0.7	Stony rough land	4,770	1.3
Sampson loam	4,480	1.2	Stony steep land	5,930	1.6
Sandy alluvial land	2,400	.7	Stony steep land, cold	10,270	2.8
Sandy wet alluvial land	4,480	1.2	Tarryall gravelly loam, 10 to 50 percent slopes	480	.1
Satanta loam	1,320	.4	Tinytown-Cheeseman complex, 5 to 30 percent slopes	2,220	.6
Satanta loam, calcareous variant, 3 to 9 percent slopes	360	.1	Truckton sandy loam, 1 to 3 percent slopes	560	.2
Satanta loam, calcareous variant, 9 to 25 percent slopes	280	.1	Truckton sandy loam, 3 to 8 percent slopes	480	.1
Stapleton loamy sand, 6 to 30 percent slopes	1,700	.5	Westcreek gravelly loam, 10 to 30 percent slopes	200	.1
Stapleton-Bresser association	9,100	2.5	Total land	360,620	100.0

1/ Less than .05 percent.

olive brown (2.5Y 5/3) when moist; massive; very hard, very friable; pH 6.8.

The A and AC horizons are light sandy loam or coarse loamy sand. The A1 horizon is 6 to 20 inches thick and is thinnest in areas that were once cultivated.

Blakeland sandy loam, 1 to 15 percent slopes (BlE).--This undulating to rolling soil occurs on uplands in the northern part of the Area. Most mapped areas are less than 160 acres in size.

Included with this soil in mapping are small areas of Truckton sandy loam, 3 to 8 percent slopes, Bresser sandy loam, 3 to 9 percent slopes, and Stapleton loamy sand. Also included are areas of Sandy alluvial land in drainageways.

Surface runoff is slow to medium, depending on slope. This soil is subject to severe soil blowing if it is tilled or cover is inadequate. The hazard of water erosion is slight to moderate. Gullies form on the steeper parts of drainageways.

Most areas of this soil are in native grass and are used for grazing livestock. Some areas have been cultivated in the past, but most of these areas have been seeded with grass. Wildlife habitat occurs in places. (Capability unit VIe-3; Sandy Foothill range site)

Blakeland-Orsa association (1 to 4 percent slopes) (Bo).--These gently sloping soils are on foot slopes and alluvial fans in the northern part of the Area. Mapped areas are long, irregular in shape, and more than 20 acres in size.

Blakeland soils make up about 50 percent of the acreage. They are mostly on small ridges and knolls. Orsa soils make up about 35 percent of the acreage and are mostly on foot slopes and in shallow swales.

Included with these soils in mapping are small areas of Bresser sandy loam, 1 to 3 percent slopes, Kassler gravelly sandy loam, and Sandy alluvial land. Also included are small areas of a soil that is more red than, but otherwise similar to, Blakeland soils.

Runoff is slow to medium. In cultivated areas the erosion hazard is slight to moderate and some gullies have formed. These soils receive runoff from soils at higher elevation.

Most of the acreage is in native grass. A few small areas are used for dryfarmed grain or irrigated alfalfa. (Capability unit IVe-5, dryland; IVs-1, irrigated; Sandy Foothill range site)

Bresser Series

The Bresser series consists of well-drained soils that formed in sandy soil material deposited by wind and water. These gently sloping to moderately steep soils are on terraces and uplands in the warmer, northern part of the Area. Slopes are 1 to 15 percent. The vegetation is mid and tall grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 52° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 5 inches thick, is grayish-brown sandy loam. The subsoil, about 25 inches thick, is dark grayish-brown sandy loam and light olive-brown and brown sandy clay loam. The underlying material is light

yellowish-brown loamy sand that extends to a depth of 60 inches or more.

Bresser soils have moderate permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Bresser soils are in grasses and are used for grazing beef cattle. Some areas are cultivated and are used for growing dryfarmed crops, mostly small grains. Alfalfa and silage corn are grown where irrigation water is available, usually along Cherry and Plum Creeks. Urban development is taking place in some areas. Wildlife habitat occurs in places.

Representative profile of a Bresser sandy loam, in native pasture, 450 feet north and 450 feet east of the center of sec. 18, T. 8 S., R. 65 W.:

A1--0 to 5 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; hard, very friable; neutral (pH 6.8); clear, smooth boundary.

B1--5 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, friable; few, thin, patchy clay films on vertical faces of peds; neutral (pH 6.8); clear, wavy boundary.

B2t--8 to 20 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; extremely hard, friable; thin patchy clay films on faces of peds; few dark streaks; neutral (pH 6.8); clear, smooth boundary.

B3t--20 to 30 inches, light olive brown (2.5Y 5/3) sandy clay loam, light olive brown (2.5Y 5/3) when moist; weak to moderate, medium, prismatic structure parting to weak to moderate, coarse, subangular blocky; extremely hard, friable; few, thin, patchy clay films on vertical faces of peds; neutral (pH 6.8); gradual, smooth boundary.

C--30 to 60 inches, light yellowish-brown (2.5Y 6/4) heavy loamy sand, light olive brown (2.5Y 5/4) when moist; very hard, very friable; few horizontal streaks of sandy clay loam less than 2 inches thick; neutral (pH 6.8).

The A1 horizon ranges from 3 to 12 inches in thickness, but in some eroded areas it is missing. Texture of the A1 horizon ranges from sandy loam to loamy sand. The B2t horizon ranges from 6 to 24 inches in thickness and from heavy sandy loam to clay loam in texture. The C horizon ranges from light yellowish brown to pale-brown in color and from loamy sand to sand in texture. Depth to bedrock is greater than 40 inches.

Bresser sandy loam, 1 to 3 percent slopes (BrB).--This nearly level soil is on terraces and uplands in the northern half of the Area. Most mapped areas are less than 60 acres in size, and most slopes are 1 to 2 percent.

Included with this soil in mapping are small areas of Sampson loam and of Truckton sandy loam, 1 to 3 percent slopes.

Surface runoff is slow. This soil is subject to moderate soil blowing where cultivated. The hazard of water erosion is slight to moderate. This soil receives water runoff from higher areas.

Most areas of this soil are cultivated. Wheat and barley are the common dryland crops. Where irrigation water is available, alfalfa and corn for silage are grown. (Capability unit IIIe-1, dryland; IIe-2, irrigated; Sandy Foothill range site)

Bresser sandy loam, 3 to 9 percent slopes (BrD).--This soil is on uplands in the northern part of the Area. Most mapped areas are less than 160 acres in size and have well established drainageways.

Included with this soil in mapping are small areas of Truckton sandy loam, 3 to 8 percent slopes, and of Bresser sandy loam, 1 to 3 percent slopes. Also included along drainageways are areas of Loamy alluvial land that seldom exceed 100 feet in width.

Runoff is medium. Soil blowing and water erosion are moderate hazards. Some gullies are present.

About half of the acreage of this soil is cultivated. Alfalfa and pasture grasses are grown on a few, small, irrigated areas along Cherry Creek. Wheat and barley are the common dryland crops. Some areas have been seeded to grass (plate III, bottom). The remaining areas are in range and are used for grazing beef cattle. (Capability unit IVe-4, dryland; IVe-2, irrigated; Sandy Foothill range site)

Bresser-Louviers complex, 7 to 30 percent slopes (BsE).--This complex is about 45 percent Bresser soils and about 30 percent Louviers soils. These sloping to steep soils are on side slopes in the northern part of the Area. In a typical area the Bresser soil is most common on the lower slopes and the Louviers soil is on knobs on the upper slopes and directly below hill crests. In most places areas of this complex exceed 40 acres in size and are irregularly shaped.

Included with these soils in mapping are areas of a Bresser-like soil that differs only in having shale bedrock at a depth of less than 30 inches and that makes up about 15 percent of each mapped area. Also included are small areas of Newlin gravelly sandy loam, 8 to 30 percent slopes, Buick-Satanta loams, 3 to 9 percent slopes, and shale and sandstone outcrops.

Runoff is medium to rapid. The erosion hazard is moderate to high. Some gullies are present along drainageways.

Most areas of these soils are used for grazing livestock. Wildlife habitat is important in places. (Bresser soils: capability unit VIe-2; Sandy Foothill range site. Louviers soils: capability unit VIe-2; Clayey Foothill range site)

Bresser-Truckton sandy loams, 5 to 25 percent slopes (BtE).--This complex is about 50 percent Bresser soils, and about 35 percent Truckton soils. The soils are sloping to steep and are in the northern part of the Area. In a typical area the Bresser soils are at lower elevations than the Truckton soils. Areas of this complex are generally 160 acres or more in size. The soils in each area are intricately mixed.

Included with these soils in mapping are areas of Blakeland sandy loam, 1 to 15 percent slopes. Also included are Newlin gravelly sandy loam, 8 to 30 percent slopes, Stapleton loamy sand, 6 to 30 percent slopes, and alluvial material along drainageways. Taken together, these areas make up 15 percent of each mapped area.

Runoff is medium to rapid. The erosion hazard is slight to moderate. Some gullies have formed along drainageways and stock trails and where cultivation has been attempted.

Most areas of this complex are in grass and are used for grazing. Urban development is taking place in some areas. (Capability unit VIe-2; Sandy Foothill range site)

Bresser and Truckton soils, 3 to 12 percent slopes, eroded (BuD2).--This undifferentiated soil group is about 50 percent Bresser soils and 35 percent Truckton soils. These are undulating to rolling soils on uplands in the northern part of the Area. In a typical area of this undifferentiated group, both soils are present, but in places only one of them is. These soils are closely associated in the landscape with Bresser-Truckton sandy loams, 5 to 25 percent slopes.

The Bresser soil has a profile similar to that described as representative for the series, but in about 40 percent of its acreage the brown sandy clay loam subsoil is exposed. In most places gullies more than 24 inches deep have exposed the material underlying the subsoil.

The Truckton soil has a profile similar to that described as representative for the series, but in about 25 percent of its acreage the brown subsoil is exposed. In most places gullies have exposed the material underlying the subsoil.

Included with these soils in mapping are areas of Newlin gravelly sandy loam, 8 to 30 percent slopes, and small areas of water-deposited sandy loams that are 20 to 30 inches deep and make up about 15 percent of the total acreage.

Because the surface crusts, runoff is medium to rapid. The erosion hazard is high. Gullies 1 to 3 feet deep and 100 to 300 feet apart are prevalent. Drainageways have cut to a depth of 3 to 6 feet.

Most areas of these soils are abandoned cultivated fields. Many areas have been seeded to grass and used for grazing. (Capability unit VIe-2, Sandy Foothill range site)

Brussett Series

The Brussett series consists of well-drained soils that formed in loamy soil material. These gently sloping soils are on tablelands. Slopes are 1 to 9 percent. The vegetation is mainly western wheatgrass, junegrass, blue grama, and mountain muhly, but there is some Gambel oak. Elevations are 6,600 to 7,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 6 inches thick, is dark grayish-brown loam. The subsoil to a depth of 26 inches is grayish-brown and brown loam and clay loam, and between depths of 26 and 51 inches the subsoil is pale-brown loam. The underlying material is light yellowish-brown loam to a depth of 60 inches or more.

Brussett soils have moderate permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Brussett soils are in grasses and some Gambel oak and are used for grazing beef cattle. Some areas are cultivated and are used to grow dryfarmed crops, mostly wheat and oats. Planted pastures are used for grazing or hay. These soils are suited to urban development.

Representative profile of a Brussett loam, 1,200 feet west and 600 feet north of the southeast corner of sec. 21, T. 10 S., R. 65 W.:

A1--0 to 6 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to moderate, fine granular; soft, very friable; neutral (pH 6.8); clear, smooth boundary.

B1--6 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure; slightly hard, very friable; few, thin, patchy clay films on vertical faces of peds; neutral (pH 6.8); clear, smooth boundary.

B21t--9 to 13 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, prismatic structure parting to strong, fine, subangular blocky; hard, firm; thin, nearly continuous clay films on faces of peds; few visible bleached sand grains on faces of soil aggregate; neutral (pH 6.8); clear, smooth boundary.

B22t--13 to 26 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium and fine, prismatic structure parting to strong, medium and fine, angular blocky; very hard, firm; thin nearly continuous clay films on faces of peds; few bleached sand grains on faces of peds; mildly alkaline (pH 7.4); gradual, smooth boundary.

B31t--26 to 39 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; thin patchy clay films on faces of peds; mildly alkaline (pH 7.6); clear, wavy boundary.

B32ca--39 to 51 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak,

coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, very friable; few patchy clay films on vertical faces of peds; strongly calcareous; few lime mycelia; moderately alkaline (pH 8.4); clear, smooth boundary.

IICca--51 to 69 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure; slightly hard, very friable; strongly calcareous; lime mycelia and lime coatings on faces of peds; strongly alkaline (pH 8.8).

The A1 horizon ranges from 4 to 9 inches in thickness and from loam to silt loam in texture. The B2t horizon ranges from 12 to 30 inches in thickness, and it is heavy loam, silty clay loam, or clay loam in texture. Lime is between depths of 20 and 40 inches. Texture of the C horizon is loam or silt loam.

Brussett loam, 1 to 3 percent slopes (BvB).--This gently sloping soil is on tablelands in the southeastern part of the Area. Most mapped areas are less than 80 acres in size and are on the top of divides.

Included with this soil in mapping are small areas of Peyton sandy loam, 1 to 3 percent slopes, and Brussett loam, 3 to 9 percent slopes. Also included are small areas of deep, black, loamy, noncalcareous soils, most of which are less than 3 acres in size. These included deep, loamy areas are most common at the top of drainageways.

Runoff is slow. The hazard of erosion is slight.

Most areas of this soil are cultivated and are used to grow wheat, oats, and planted pasture grasses. (Capability unit IIIc-1; Loamy Park range site)

Brussett loam, 3 to 9 percent slopes (BvD).--This sloping soil is on tablelands in the southern part of the Area. Most mapped areas are less than 160 acres in size and have well established drainageways.

Included with this soil in mapping are small areas of Brussett loam, 1 to 3 percent slopes, Peyton sandy loam, 3 to 9 percent slopes, and small areas of Jarre soils that are on knobs and close to drainageways. Also included along drainageways are areas of Loamy alluvial land that seldom exceed 50 feet in width.

Runoff is medium to rapid. The hazard of erosion is moderate, especially during snowmelt in the spring when the ground is frozen. Gullies 1 to 3 feet deep are present in some cultivated fields.

About three-fourths of the acreage is in native grass and scattered Gambel oak. Gambel oak is most common on north-facing slopes. The rest of the acreage is cultivated and is used to grow wheat, oats, and planted pasture grasses. (Capability unit IVe-3; Loamy Park range site)

Buick Series

The Buick series consist of well-drained soils that formed in eolian sediments lying over relatively silty alluvial materials. These gently sloping to sloping soils are on uplands. Slopes are 3 to 9 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,800 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile, the surface layer, about 4 inches thick, is grayish-brown loam. The upper part of the subsoil, about 18 inches thick, is brown and pale-brown silty clay loam to loam. Below this is brown, calcareous sandy clay loam and clay loam extending to a depth of 60 inches or more (plate IV, left).

Buick soils have moderate permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Buick soils are in native grasses and are used for grazing livestock. Some areas are cultivated and are used to grow dryfarmed crops, mostly small grains.

Representative profile of a Buick loam, 2,640 feet west of the southeast corner of sec. 26, T. 7 S., R. 66 W.:

A1--0 to 4 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; slightly hard, very friable; neutral (pH 7.2); clear, smooth boundary.

B21t--4 to 10 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, friable; thin patchy clay films on faces of peds; neutral (pH 7.2); clear, smooth boundary.

B22tca--10 to 15 inches, pale-brown (10YR 6/3) light silty clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, very friable; thin patchy clay films on faces of peds; strongly calcareous; moderately alkaline (pH 8.2); clear, smooth boundary.

B3ca--15 to 22 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; thin patchy clay films on vertical faces of peds; few, fine, lime-coated pebbles; very strongly calcareous with few distinct lime concretions; moderately alkaline (pH 8.2); gradual, smooth boundary.

IIB21bca--22 to 46 inches, brown (7.5YR 5/4 when dry and moist) heavy sandy clay loam; strong, coarse, prismatic structure; very hard, friable; thin patchy clay films on vertical faces

of peds; very strongly calcareous, with common, medium, distinct lime concretions; moderately alkaline (pH 8.2); diffuse, smooth boundary.

IIB22bca--46 to 64 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium and coarse, prismatic structure; hard, friable; thin patchy clay films on faces of peds; very strongly calcareous, with many lime streaks and lime mycelia and few concretions; moderately alkaline (pH 8.2).

The A1 horizon ranges from 2 to 6 inches in thickness and from loam to sandy loam in texture. The B horizon ranges from 6 to 28 inches in thickness. Lime is between depths of 10 and 20 inches. The IIB horizon ranges from sandy clay loam to clay loam in texture. The gravel content ranges from 0 to 10 percent.

Buick-Satanta loams, 3 to 9 percent slopes (BwD).--This complex is about 50 percent Buick soils and about 40 percent Satanta soils. These gently sloping to sloping soils are on uplands in the northern part of the Area. In a typical area the Buick soils are at lower elevations and Satanta soils are on ridgetops and at higher elevations. Soil areas are irregularly shaped and ordinarily are more than 40 acres in size.

Included with these soils in mapping are areas of Fondis clay loam, 3 to 9 percent slopes, Bresser sandy loam, 1 to 3 percent slopes, and Newlin gravelly sandy loam, 8 to 30 percent slopes. Taken together, these soils make up about 10 percent of each mapped area.

Runoff is medium. The erosion hazard is moderate.

About half of the acreage is in native pasture and is used for grazing livestock. The rest is cultivated and used to grow irrigated and dryland crops. Corn for silage, alfalfa, and small grain are the main irrigated crops. Wheat is the main dryland crop. (Capability unit IVe-3, dryland; IVe-1, irrigated; Loamy Foothill range site)

Chaseville Series

The Chaseville series consists of somewhat excessively drained soils that formed in sandy alluvial soil materials. These moderately steep to very steep soils are on ridges and side slopes in the western part of the Area. Slopes are 20 to 70 percent. The vegetation is Gambel oak and mountain-mahogany and some native grass. Elevations are 6,200 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual air temperature is 45° to 48° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer, about 9 inches thick, is reddish-brown very gravelly sandy loam. The underlying material is reddish-brown very gravelly light sandy loam and very gravelly loamy sand extending to a depth of 60 inches or more.

Chaseville soils have rapid to very rapid permeability. Available water capacity is low. Plant roots can penetrate to a depth of 60 inches or more.

Areas of Chaseville soils are used for grazing livestock and wildlife habitat.

The Chaseville soils in the Area are mapped only in a complex with Redridge soils. This mapping unit is described under the heading "Redridge Series."

Representative profile of a Chaseville sandy loam, 1,800 feet south and 200 feet east of the northwest corner of sec. 4, T. 9 S., R. 68 W.:

A1--0 to 9 inches, reddish-brown (5YR 5/3) very gravelly sandy loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; soft, very friable; 60 percent gravel, most of which is fine, angular, granitic fragments; slightly acid (pH 6.4); gradual, smooth boundary.

C1--9 to 14 inches, reddish-brown (5YR 5/3) very gravelly light sandy loam, reddish brown (5YR 4/3) when moist; massive or very weak, medium, subangular blocky structure; very hard, very friable; 60 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); gradual, wavy boundary.

C2--14 to 60 inches, reddish-brown (5YR 5/3) very gravelly loamy sand, reddish brown (5YR 4/3) when moist; single grain; loose when dry and moist; 60 to 70 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6).

The A horizon ranges from 7 to 20 inches in thickness. The content of gravel ranges from 50 to 80 percent. The C2 horizon is at depths of 10 to 25 inches. In places shale or bedrock is at a depth of 50 inches or more.

Cheeseman Series

The Cheeseman series consists of moderately deep, well-drained soils that formed in material weathered from interbedded sandstone and shale. These sloping to moderately steep soils are on uplands in the southwestern part of the Area. Slopes are 5 to 15 percent. The vegetation is dominantly short and mid grasses, but Gambel oak and mountain-mahogany are common. Elevations are 6,200 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer, about 11 inches thick, is dark reddish-gray and reddish-brown loam. The subsoil, about 20 inches thick, is reddish-brown and red clay loam that grades to gravelly sandy loam. Bedrock at a depth of about 31 inches is reddish-brown interbedded shale and sandstone.

Cheeseman soils have moderate permeability. Available water capacity is low. Plants can penetrate to bedrock.

Most areas of Cheeseman soils are used for grazing livestock. A few areas have been cultivated, but most have been reseeded to grass.

The Cheeseman soils in the Area are mapped only in a complex with Tinytown soils. This mapping unit is described under the heading "Tinytown Series."

Representative profile of a Cheeseman loam, 400 feet north and 1,320 feet west of the southeast corner of sec. 32, T. 10 S., R. 67 W.:

A1--0 to 4 inches, dark reddish-gray (5YR 4/2) loam, dark reddish brown (5YR 2/2) when moist; moderate, medium, granular structure; soft, very friable; 5 percent, fine and very fine granitic gravel; neutral (pH 6.8); clear, smooth boundary.

A3--4 to 11 inches, reddish-brown (2.5YR 4/3) loam, dusky red (2.5YR 3/2) when moist; moderate, fine, subangular blocky structure; slightly hard, friable; 10 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); clear, smooth boundary.

B21t--11 to 16 inches, reddish-brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) when moist; weak to moderate, coarse, prismatic structure parting to moderate, fine, subangular blocky; very hard, friable; many, thin, patchy clay films on both horizontal and vertical faces of peds; 10 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); clear, smooth boundary.

B22t--16 to 24 inches, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) when moist; weak to moderate, coarse, prismatic structure parting to moderate, fine, subangular blocky; very hard, friable; many, thin, patchy clay films on horizontal and vertical faces of peds; 15 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); clear, smooth boundary.

B3--24 to 31 inches, red (2.5YR 5/6) gravelly sandy loam, red (2.5YR 4/6) when moist; weak, coarse, subangular blocky structure; very hard, very friable; few, thin, patchy clay films on faces of peds; 30 percent fine gravel; neutral (pH 6.8); clear, smooth boundary.

R--31 to 60 inches, interbedded reddish-brown shale and sandstone.

The A horizon ranges from 6 to 16 inches in thickness. The content of gravel is from 0 to 15 percent. The B horizon ranges from 12 to 21 inches in thickness. In the upper part of the B horizon the gravel content is 5 to 20 percent, and in the lower part it is from 15 to 35 percent. Bedrock is at a depth of 20 to 40 inches.

Coni Series

The Coni series consists of shallow, well-drained soils that formed in arkosic sedimentary rock overlying unweathered conglomerate. These gently sloping to sloping soils are at or near the edge of tablelands in the southern part of the Area. Slopes are 3 to 15 percent. The vegetation is dominantly short and mid grasses, but in places there are pine trees and brush. Elevations are 6,600 to 7,800 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 7 inches thick, is dark grayish-brown loam. The subsoil, about 10 inches thick, is a brown to pale-brown clay loam to sandy clay loam that rests on hard conglomerate at a depth of 17 inches or less.

Coni soils have moderate permeability. Available water capacity is low. Plants can penetrate to a depth of 20 inches or less.

Most areas of Coni soils are in native grasses and are used for grazing livestock and for wildlife habitat.

Representative profile of Coni loam, in native pasture, 1,585 feet south of the northwest corner of sec. 21, T. 10 S., R. 65 W.:

A1--0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; moderate, very fine, granular structure; soft, very friable; 5 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); clear, smooth boundary.

B2t--7 to 14 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, very friable; many, thin, patchy clay films on faces of peds; 5 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); clear, smooth boundary.

B3t--14 to 17 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; extremely hard, very friable; few, thin, patchy clay films on vertical faces of peds; 10 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); abrupt, smooth boundary.

R--17 inches, hard, silicate-cemented conglomerate.

The A horizon ranges from 3 to 10 inches in thickness and from clay loam to sandy loam in texture. The B2t horizon ranges from 6 to 16 inches in thickness and from sandy clay loam to clay loam in texture. Depth to conglomerate ranges from 10 to 20 inches.

Coni rocky loam, 3 to 100 percent slopes (CoG).--This complex is about 70 percent Coni loam and about 15 percent Rock outcrop. This complex is on or near tableland edges in the southern part of the Area. It is made up of long, narrow bands about 1,000 feet or less in width and extending for several miles in length. In most places these areas are more than 100 acres in size. In a typical area of this complex Coni loam has slopes of 3 to 15 percent; the Rock outcrop is mainly near nearly vertical cliffs (plate IV, right).

Included in mapping are areas of Brussett loam, 3 to 9 percent slopes, Kettle sandy loam, Stony rough land, and Kettle and Falcon soils. Taken

together these areas make up 15 percent of each mapped area.

Surface runoff is rapid. The hazard of water erosion is moderate to severe, especially in the spring during snowmelt.

Most areas of this complex are used for grazing livestock. The panaramic view from areas of this complex make it a popular site for homes. (Capability unit VIIe-1; Loamy Park range site)

Crowfoot Series

The Crowfoot series consists of well-drained soils that formed in sediments weathered from arkose. These gently sloping to moderately steep soils are on uplands in the southern part of the Area. Slopes are 3 to 15 percent. The vegetation is mid and tall grasses and Gambel oak, but in places there is some ponderosa pine. Elevations are 6,600 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile, the surface layer, about 11 inches thick, is dark grayish-brown sandy loam and loamy sand. Below this is a layer of light-gray loamy sand about 8 inches thick. The subsoil, about 15 inches thick, is light brownish-gray gravelly clay loam and gravelly sandy clay loam. The underlying material is white gravelly sandy loam and coarse sand extending to a depth of 60 inches or more.

Crowfoot soils have moderate permeability. Available water capacity is moderate.

Most areas of these soils are in native grasses, Gambel oak, and some ponderosa pine. These soils are used for grazing beef cattle, for wildlife habitat, and for recreation. They are a good source of roadfill material.

Representative profile of a Crowfoot sandy loam, 1,320 feet west and 85 feet north of the southeast corner of the northeast quarter of sec. 28, T. 10 S., R. 66 W.:

A11--0 to 6 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft, very friable; slightly acid (pH 6.5); clear, wavy boundary.

A12--6 to 11 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose; 5 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); clear, wavy boundary.

A2--11 to 16 inches, light-gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) when moist; weak, thin, platy structure; soft, very friable; 5 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); clear, smooth boundary.

A&B--16 to 19 inches, light variegated colors; light-gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) when moist; contains nodules and concretions of sandy clay loam that are grayish brown (10YR 5/2) to dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; hard, firm; few patchy clay films on faces of peds and in seams and nodules of the finer textured material; 10 percent gravel; neutral (pH 6.6); clear, wavy boundary.

B21t--19 to 24 inches, light brownish-gray (10YR 6/2) gravelly clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, firm; thin continuous clay films on faces of peds; 15 percent fine gravel; neutral (pH 6.6); clear, smooth boundary.

B22t--24 to 32 inches, light brownish-gray (2.5Y 6/2) gravelly sandy clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, firm; thin patchy clay films on faces of peds; 15 percent fine granitic gravel; neutral (pH 6.6); gradual, wavy boundary.

C1--32 to 43 inches, white (2.5Y 8/1) gravelly sandy loam showing vertical streaks 1 to 3 feet apart; streaks strong brown (7.5YR 5/6) when dry and light gray (2.5Y 7/1) when moist; massive; extremely hard, friable; 10 percent fine and very fine granitic gravel; neutral (pH 6.6); gradual, wavy boundary.

C2--43 to 60 inches, white (2.5Y 8/2, when dry and moist) coarse sand; contains streaks 1 to 3 feet apart; streaks strong brown (7.5YR 5/6) when dry and light gray (2.5Y 7/1) when moist; massive; extremely hard, very friable; 5 percent fine and very fine granitic gravel; neutral (pH 6.6).

The A1 horizon ranges from 5 to 12 inches in thickness. The A2 horizon ranges from 2 to 14 inches in thickness. The B horizon ranges from 10 to 40 inches or more in thickness and from gravelly loam to sandy clay loam in texture. The content of gravel is 15 percent or less.

Crowfoot-Tomah sandy loams, 5 to 25 percent slopes (CrE).--This complex consists of about 50 percent Crowfoot sandy loam and 50 percent Tomah sandy loam. The soils in each area are intricately mixed. These sloping to steep soils are on alluvial fans and upland hills and ridges. In most places soil areas contain many drainageways and knobs and exceed 160 acres in size.

Included with these soils in mapping are areas of Kettle sandy loam and Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes. A soil similar to the Crowfoot soil but warmer is included near the old Hilltop station. In places drainageways contain small wet areas that have springs.

Runoff is medium. The erosion hazard is slight to moderate. Gullies are present in some drainageways or along stock trails.

These areas are used for grazing livestock and wildlife habitat. Gambel oak is common. (Capability unit VIe-3; Sandy Divide range site)

Cruckton Series

The Cruckton series consists of well-drained soils that formed in thick deposits weathered from arkosic sedimentary rock. These gently undulating to rolling soils are on uplands in the southern part of the Area. Slopes are 1 to 15 percent. The vegetation is mid and tall grasses. Elevations are 6,600 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 8 inches thick, is dark grayish-brown sandy loam. The subsoil, about 22 inches thick, is yellowish-brown and pale-brown sandy loam. The underlying material is very pale brown light sandy loam and gravelly sandy loam extending to a depth of 60 inches or more.

Cruckton soils have moderately rapid permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

About two-thirds of Cruckton soils are in native grasses and are used for grazing. The remainder is cultivated and used mainly for dryfarmed crops. A few small areas are sprinkler irrigated. Urban development is taking place in some areas. These soils are a good source of material for road fill.

Representative profile of a Cruckton sandy loam, in native pasture, 1,320 feet east and 1,200 feet south of the northwest corner of sec. 22, T. 10 S., R. 66 W.:

A1--0 to 4 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; neutral (pH 6.6); clear, smooth boundary.

A3--4 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, very friable; neutral (pH 6.6); clear, smooth boundary.

B2t--8 to 18 inches, yellowish-brown (10YR 5/4) sandy loam, brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, very friable; many, thin patchy clay films on vertical and horizontal faces of peds; neutral (pH 6.6); gradual, smooth boundary.

B3t--18 to 30 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; weak to moderate, medium, subangular blocky structure; very hard, very friable; few, thin, patchy clay films on vertical faces of peds; neutral (pH 6.6); gradual, wavy boundary.

C1--30 to 40 inches, very pale brown (10YR 7/4) light sandy loam, pale brown (10YR 6/3) when moist; massive; very hard, very friable; neutral (pH 6.8); clear, wavy boundary.

C2--40 to 60 inches, very pale brown (10YR 7/3) fine gravelly sandy loam, pale brown (10YR 6/3) when moist; massive; very hard, very friable; neutral (pH 6.8).

The Cruckton soils are uniform throughout the survey area and have only minor differences in thickness of the A and B horizons. The C horizon ranges from sand to gravelly loam or loam in texture.

Cruckton sandy loam, 1 to 9 percent slopes (CsD).--This gently undulating to sloping soil is on alluvial fans, valley side slopes, and hills and ridges on uplands in the southern part of the Area. Most mapped areas are elongated and 40 to 200 acres in size.

Included with this soil in mapping are small areas of Peyton sandy loam, 3 to 9 percent slopes, and Kippen loamy sand, 1 to 20 percent slopes. Also included are a few, small potholes on the undulating slopes and a darker sandy soil less than 100 feet wide that is on drainageways.

Runoff is slow to medium. The hazard of erosion is moderate. In places runoff from snowmelt in the spring causes rills and small gullies on cultivated fields.

About half the acreage is in native grass and is used for grazing livestock. The rest of the acreage is cultivated and used for growing small grain and ensilage corn. Tame pasture has been planted on some cultivated areas. (Capability unit IVe-3; Sandy Divide range site)

Cruckton-Peyton sandy loams, 7 to 20 percent slopes (CtE).--This complex consists of about 50 percent Cruckton sandy loam and about 30 percent Peyton sandy loam. These strongly sloping to hilly soils are on uplands in the southern part of the Area. The Cruckton soil is at higher elevations than the Peyton soil. In most places soil areas are less than 200 acres in size.

Cruckton soil has a profile similar to that described as representative for the series.

The Peyton soil has a profile similar to that described as representative for the series, but the surface layer is about 7 inches thick.

Included with these soils in mapping are areas of Kippen loamy sand, 1 to 20 percent slopes, Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes, and rock outcrops. Taken together, these areas make up 20 percent of each mapped area.

Runoff is medium to rapid. The erosion hazard is slight to moderate except in areas that are overgrazed. Some gullies are present in drainageways.

Most of these areas are used for grazing livestock. (Capability unit VIe-3; Sandy Divide range site)

Denver Series

The Denver series consists of well-drained soils that formed in clayey soil materials. These sloping to moderately steep soils are on uplands in the northwestern part of the Area. Slopes are 5 to 12 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 7 inches thick, is grayish-brown to dark grayish-brown clay loam. The subsoil, about 38 inches thick, is brown, pale-brown, and light yellowish-brown clay and heavy clay loam. The lower part of the subsoil contains prominent, coarse lime mottles and is strongly calcareous. The underlying material, to a depth of 55 inches or more, is very pale brown clay loam that is strongly calcareous.

Denver soils have slow permeability. Available water capacity is high. Plants can penetrate to a depth of 40 inches or more.

Most areas of Denver soils are in native pasture and are used for grazing.

Representative profile of a Denver clay loam, in native pasture, 1,320 feet south and 400 feet west of the center of sec. 12, T. 7 S., R. 69 W.:

A11--0 to 2 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, friable; neutral (pH 6.8); abrupt, smooth boundary.

A12--2 to 7 inches, dark-grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; strong, medium and fine, granular structure; slightly hard, friable; neutral (pH 6.8); abrupt, smooth boundary.

B21t--7 to 15 inches, brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure parting to strong, coarse, angular blocky; extremely hard, very firm; clay films are nearly continuous on faces of peds; loose, bleached sand grains on aggregate faces; prisms have 5 degree horizontal tilt, slickensides are present on faces of peds; neutral (pH 6.6); clear, smooth boundary.

B22t--15 to 24 inches, pale-brown (10YR 6/3) clay, brown (10YR 5/3) when moist; strong, medium and coarse, prismatic and angular blocky structure; extremely hard, very firm; strongly calcareous; moderately alkaline (pH 8.2); clear, wavy boundary.

B3ca--24 to 45 inches, light yellowish-brown (2.5Y 6/3) heavy clay loam, light olive brown (2.5Y 5/3) when moist; moderate, medium, prismatic structure; very hard, firm; strongly calcareous with prominent, coarse lime mottles; moderately alkaline (pH 8.2); gradual, wavy boundary.

C--45 to 55 inches, very pale brown (10YR 7/4) clay loam, light olive brown (2.5Y 5/3) when moist; weak, coarse, subangular blocky structure; very hard, firm; strongly calcareous; moderately alkaline (pH 8.2).

The A horizon ranges from 4 to 8 inches in thickness and from clay loam to silty clay in texture. The B horizon ranges from 12 to 40 inches in thickness and becomes calcareous between depths of 12 and 40 inches. In places shale is at depths below 40 inches.

Denver clay loam, 5 to 12 percent slopes (DeD).--This sloping to moderately steep soil is on uplands in the northwestern part of the Area. Most mapped areas are irregularly shaped and about 100 acres in size.

Included with this soil in mapping are small areas of Fondis clay loam, 3 to 9 percent slopes. Also included are areas less than 2 acres in size that have a surface layer 3 to 4 inches thick and a thin, gray layer below. These areas are small depressions in the landscape. Also included are darker colored soils less than 100 feet wide that lie along drainageways.

Runoff is rapid. The hazard of erosion is moderate to high.

All areas of this soil are used for grazing. (Capability unit VIe-1; Clayey Foothill range site)

Englewood Series

The Englewood series consists of well-drained soils that formed in alluvium weathered from sedimentary bedrock. The nearly level to gently sloping soils are on alluvial fans and valley side slopes along major drainageways. Slopes are 1 to 4 percent. The vegetation is mid and tall grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 52° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 6 inches thick, is grayish-brown clay loam. The subsoil is grayish-brown and dark grayish-brown clay about 23 inches thick. The underlying material is light brownish-gray and grayish-brown clay that contains some soft calcium carbonate concretions and extends to a depth of 60 inches or more.

Englewood soils have very slow permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Englewood soils are in native grasses and are used for grazing livestock. Some areas along Cherry Creek are cultivated and are used for growing irrigated crops.

Representative profile of an Englewood clay loam, 1,000 feet east and 100 feet north of the southwest corner of sec. 15, T. 6 S., R. 66 W.:

A1--0 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, friable; neutral (pH 7.0); clear, smooth boundary.

B1--6 to 10 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; hard, friable; few patchy clay films on vertical faces of peds; mildly alkaline (pH 7.4); clear, smooth boundary.

B2t--10 to 29 inches, dark grayish-brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) when moist; moderate, coarse, prismatic structure parting to moderate, medium, angular and subangular blocky; extremely hard, very firm; thin nearly continuous clay films on vertical and horizontal faces of peds; a few slickensides; moderately alkaline (pH 8.0); abrupt, wavy boundary.

C1--29 to 44 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure parting to moderate, coarse, subangular blocky; extremely hard, very firm; few, medium, distinct lime and gypsum nodules; noncalcareous except on or near lime concretions; moderately alkaline (pH 8.4); gradual, wavy boundary.

C2--44 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; massive; very hard, firm; moderately alkaline (pH 8.4).

The A horizon ranges from 3 to 8 inches in thickness and from silt loam to clay in texture. The B2t horizon ranges from 12 to 30 inches in thickness and from dark grayish brown to dark brown in color. The C horizon ranges from clay to clay loam in texture. Depth to lime is 12 to 30 inches.

Englewood clay loam (1 to 4 percent slopes) (En).--This nearly level to gently sloping soil occurs in upland swales or terraces, mainly in the northeastern part of the Area. Most mapped areas are less than 80 acres in size.

Included with this soil in mapping are areas of Sampson loam and Satanta loam. Rock outcrop less than 100 feet in diameter occurs in some places on uplands. Also included are small areas of an Englewood-like soil that has shale or siltstone at depths of 20 to 40 inches.

Runoff is medium. The hazard of erosion is slight. Small areas of this soil receive runoff from higher lying areas.

Most areas of this soil are used for grazing livestock. A few areas along Cherry Creek are used mainly to grow irrigated crops. Some dryland wheat is also grown. (Capability unit IVs-2, dryland; IIIs-1, irrigated; Clayey Foothill range site)

Falcon Series

The Falcon series consists of shallow, somewhat excessively drained soils that formed in sediments weathered from arkosic sandstone and conglomerate. These moderately steep to steep soils are on upland ridges and hill crests in the southern part of the Area. Slopes are 10 to 30 percent. The vegetation is mainly ponderosa pine, Gambel oak, mountain-mahogany, and mid and tall grasses. Elevations are 6,600 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 7 inches thick, is dark grayish-brown sandy loam. The next layer, about 7 inches thick, is a light-gray gravelly sandy loam that overlies the hard arkosic sandstone and conglomerate at a depth of 20 inches or less.

Falcon soils have moderately rapid permeability. Available water capacity is low. Plants can penetrate to a depth of 20 inches or less.

Most areas of Falcon soils are in native vegetation and are used for pasture, recreation, and wildlife habitat. The trees are a source of fencing materials.

The Falcon soils in the Area are mapped only in a complex with Kettle soils. This mapping unit is described under the heading "Kettle Series."

Representative profile of a Falcon sandy loam, on the east side of Colorado State Highway No. 83, 500 feet north of the southwest corner of sec. 35, T. 10 S., R. 66 W.:

O1--1 inch to 0, pine needles and partly decomposed litter and twigs.

A1--0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 10 percent gravel; neutral (pH 6.8); clear, smooth boundary.

C--7 to 14 inches, light-gray (10YR 7/2) gravelly sandy loam, grayish brown (10YR 5/2) when moist; weak, medium, subangular blocky structure; very hard, very friable; 20 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); abrupt, smooth boudary.

R--14 to 20 inches, hard arkosic sandstone or conglomerate.

The A horizon ranges from 4 to 12 inches in thick ness and from sandy loam or gravelly sandy loam in texture. Gravel content ranges from 5 to 30 percent. The C horizon is a gravelly sandy loam, and the gravel content ranges from 15 to 35 percent. Depth to bedrock ranges from 4 to 20 inches.

Fondis Series

The Fondis series consists of well-drained soils that formed in eolian soil materials 1 to 2 feet thick that overlie coarser textured outwash materials derived from arkosic sedimentary rock. These gently sloping to steep soils are on uplands in the northern part of the Area. Slopes are 1 to 40 percent. The vegetation is short and tall grasses. Elevations are 5,500 to 6,800 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 7 inches thick, is dark grayish-brown clay loam. The upper part of the subsoil, about 21 inches thick, is brown, grayish-brown, and light yellowish-brown clay. The lower part of the subsoil is very strongly calcareous sandy clay loam. The underlying material is a buried soil that is brown and reddish-yellow sandy clay loam. It extends to a depth of 60 inches or more, is very strongly calcareous, and contains streaks of lime 2 to 6 inches wide.

Fondis soils have slow permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more, except where bedrock is at a depth of about 40 inches or below.

Most areas of Fondis soils are in native grasses and used for grazing livestock. Some of the less sloping areas are dryfarmed.

Representative profile of a Fondis clay loam, in a cultivated field, 122 feet west of the southeast corner of sec. 19, T. 8 S., R. 66 W.:

Ap1--0 to 5 inches, dark grayish-brown (10YR 4/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft, friable; neutral (pH 7.0); abrupt, smooth boundary.

Ap2--5 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish-brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; hard, firm; cultivation marks present; neutral (pH 7.0); abrupt, smooth boundary.

B21t--7 to 12 inches, brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure parting to strong, fine, angular blocky; very hard, very firm; thin continuous clay films on faces of peds; neutral (pH 7.2); clear, smooth boundary.

B22t--12 to 24 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; moderate, medium to fine, prismatic structure parting to strong, fine, angular blocky; very hard, very firm; thin nearly continuous clay films on faces of peds; many slickensides; mildly alkaline (pH 7.4); abrupt, smooth boundary.

B23ca--24 to 28 inches, light yellowish-brown (10YR 6/4) heavy sandy clay loam with few dark-brown (10YR 4/3) streaks 1/4 to 1/2 inch wide; this sandy clay loam yellowish brown (10YR 5/4) when moist to brown (10YR 5/3) when moist and crushed; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; very hard, very firm; thin patchy clay films on faces of peds; very strongly calcareous with few lime mycelia; moderately alkaline (pH 8.2); clear, smooth boundary.

IIB24ca--28 to 45 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium to coarse, subangular blocky structure; hard, firm; few, thin, patchy clay films on faces of peds; 5 percent fine gravel; very strongly calcareous with common lime mycelia; moderately alkaline (pH 8.2); gradual, smooth boundary.

IIB3ca--45 to 57 inches, reddish-yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) when moist; weak, coarse, prismatic structure; hard, firm; few, thin, patchy clay films on vertical faces of peds; very strongly calcareous with lime streaks 2 to 6 inches wide; moderately alkaline (pH 8.2); gradual, smooth boundary.

IICca--57 to 60 inches, pink (7.5YR 7/4) light sandy clay loam, light brown (7.5YR 6/4) when moist; massive; hard, friable; very strongly calcareous; lime increases with depth; moderately alkaline (pH 8.2).

The A horizon ranges from 3 to 8 inches in thickness and from loam to clay loam in texture. Where cultivated, the A horizon is mixed with the B horizon and the texture is clay loam. The B horizon ranges from 12 to 28 inches in thickness. Depth to lime ranges from 12 to 30 inches. The IIB horizon is in contact with the B horizon and extends to a depth of greater than 40 inches, and in some places, to a depth of 10 feet. In places shale or sandstone is at a depth of below 40 inches.

Fondis clay loam, 1 to 3 percent slopes (FoB).--This gently sloping soil is on tablelands and uplands in the northern part of the Area. Most mapped areas are irregularly shaped and 20 to 400 acres in size.

Included with this soil in mapping are small areas of Fondis clay loam, 3 to 9 percent slopes, Kutch clay loam, 4 to 8 percent slopes, and Buick-Satanta loams, 3 to 9 percent slopes. Also included are small rock outcrops and a few lakes that form during periods of intensive amounts of rainfall.

Runoff is medium. The hazard of erosion is slight to moderate. A few gullies are in drainageways.

Most areas of this soil are cultivated and are used to grow wheat, barley, and oats. (Capability unit IIIc-1, dryland; IIe-1, irrigated; Clayey Foothill range site)

Fondis clay loam, 3 to 9 percent slopes (FoD).--This sloping soil is on uplands in the northern part of the Area. Most mapped areas are irregularly shaped and range from 40 to 600 acres in size.

Included with this soil in mapping are small areas of Kutch clay loam, 4 to 8 percent slopes, Englewood clay loam, and Denver clay loam, 5 to 12 percent slopes. Also included are a few rock outcrops less than a quarter acre in size.

Runoff is medium. The hazard of erosion is moderate. Gullies are on some of the larger drainageways not protected by grass.

Most areas of this soil are cultivated and are used to grow small grains, mainly wheat. A few areas are in native pasture and are used for grazing livestock. (Capability unit IVe-3, dryland; IVe-1, irrigated; Clayey Foothill range site)

Fondis-Kutch association (5 to 40 percent slopes) (Fu).--This association is about 50 percent Fondis loam and about 35 percent Kutch sandy loam. These strongly sloping to steep soils are on uplands in the northern part of the Area. In a typical area the Fondis soils are at higher elevations than the Kutch soils.

The Fondis soil has a profile similar to that described as representative for the series, but the surface layer, about 4 inches thick, is loam. Shale or sandstone is at a depth of 40 inches or more.

The Newlin soil has a profile similar to that described as representative for the series, but it has a surface layer of sandy loam 3 to 4 inches thick.

Included with these soils in mapping are areas of Newlin gravelly sandy loam, 8 to 30 percent slopes, and Bresser sandy loam, 3 to 9 percent slopes. Also included are a few small areas of Hilly gravelly land that are less than 5 acres in size and a few cliffs that are about 30 to 40 feet high. Taken together these areas make up about 15 percent of each mapped area.

Runoff is medium to rapid. The erosion hazard is moderate to severe. In many places small slips, or "catsteps," 6 to 12 inches high are present where slopes exceed 9 percent. Gullies and headcuts are present along drainageways.

These areas are used for grazing livestock and for wildlife habitat. (Fondis soils: capability unit VIe-1; Loamy Foothill range site. Kutch soils: capability unit VIe-1; Clayey Foothill range site)

Garber Series

The Garber series consists of well-drained soils that formed in alluvial soil materials weathered from red-colored arkosic sedimentary rock. These sloping to steep soils are on alluvial fans and valley side slopes. Slopes are 5 to 30 percent. The vegetation is mainly tall and mid grasses, but in places mountain-mahogany and Gambel oak are present. Elevations are 6,200 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is about 46° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer, about 30 inches thick, is dark reddish-gray and reddish-gray gravelly and very gravelly sandy loam that contains an average of 60 percent gravel. The underlying material is reddish-brown very gravelly sandy loam containing about 70 percent gravel. Granite bedrock is at a depth of greater than 40 inches and in places is below a depth of 60 inches.

Garber soils have rapid permeability. Available water capacity is low. Plants can penetrate to a depth of 40 inches or more.

Most areas of Garber soils are in native grasses and are used for grazing. Wildlife habitat occurs in places. Urban development has taken place in some areas. These soils are also used for road fill material.

Representative profile of a Garber gravelly sandy loam, 800 feet south and 100 feet east of the northwest corner of sec. 4, T. 9 S., R. 68 W.:

A11--0 to 8 inches, dark reddish-gray (5YR 4/2) gravelly sandy loam, dark reddish brown (5YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 60 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); gradual, smooth boundary.

A12--8 to 20 inches, reddish-gray (5YR 5/2) very gravelly sandy loam, dark reddish brown (5YR 2/2) when moist; weak, coarse, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; 60 percent, fine and very fine, angular, granitic gravel; neutral (pH 6.8); gradual, smooth boundary.

A13--20 to 30 inches, reddish-gray (5YR 5/2) very gravelly sandy loam, dark reddish brown (5YR 3/2) when moist; weak, coarse, subangular blocky structure parting to moderate, fine, granular; very hard, very friable; 60 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); gradual, wavy boundary.

C--30 to 60 inches, reddish-brown (5YR 5/3) very gravelly sandy loam, reddish brown (5YR 4/3) when moist; massive; very hard, very friable; 70 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8).

The A horizon ranges from 20 to 36 inches in thickness and from very gravelly sandy loam to very gravelly loam in texture. The C horizon ranges from very gravelly sandy loam to very gravelly loam. The gravel content in the soil profile ranges from 50 to 70 percent.

Garber gravelly sandy loam, 5 to 30 percent slopes (GaE).--This sloping to steep soil is on alluvial fans, valley side slopes, and small stream bottoms in the western part of the Area. Most mapped areas are large and irregularly shaped.

Included with this soil in mapping are small areas of Juget soils, Kassler gravelly sandy loam, and Tinytown soils.

Runoff is slow to medium. The hazard of erosion is slight to moderate. Some gullies form because of runoff from adjacent areas.

Most areas of this soil are in native grass (plate V, top) and are used for grazing livestock. In the extreme southwestern part of the Area, about 400 acres is covered with trees, mainly ponderosa pine. (Capability unit VIe-4; Loamy Park range site)

Gove Series

The Gove series consists of well-drained soils that formed in alluvium derived from reddish-brown arkosic sedimentary rock or granite. These strongly

sloping to steep soils are on valley side slopes along Jarre Creek east of the mountains. Slopes are 5 to 20 percent. The vegetation is mainly mid and tall grasses, but some areas have Gambel oak, mountain-mahogany, and a few ponderosa pines. Elevations are 6,100 to 6,600 feet. Annual precipitation is 15 to 18 inches. Mean annual soil temperature is 48° to 50° F., and the frost-free season is 120 to 130 days.

In a representative profile the surface layer, about 17 inches thick, is brown sandy loam. The subsurface layer, about 9 inches thick, is pink loamy sand. The subsoil is reddish-brown sandy clay loam about 28 inches thick. The underlying material is light reddish-brown gravelly sandy loam extending to a depth of 60 inches or more.

Gove soils have moderate permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Gove soils are in native grasses and are used for grazing livestock. A few areas are cultivated, but most are seeded to grass.

Representative profile of a Gove sandy loam, 700 feet west and 500 feet north of the southeast corner of sec. 28, T. 7 S., R. 68 W.:

A1--0 to 17 inches, brown (7.5YR 5/2) sandy loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; 5 percent fine, angular, granitic gravel; medium acid (pH 6.0); clear, smooth boundary.

A2--17 to 28 inches, pink (7.5YR 7/4) loamy sand, brown (7.5YR 5/4) when moist; massive; hard, very friable; 5 percent gravel; strongly acid (pH 5.5); clear, smooth boundary.

B2t--28 to 50 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; extremely hard, very friable; thin nearly continuous clay films on faces of peds; 5 percent fine and very fine, angular, granitic gravel; medium acid (pH 6.0); gradual, smooth boundary.

B3--50 to 56 inches, reddish-brown (5YR 3/4) gravelly sandy loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; extremely hard, very friable; few, thin, patchy clay films on the vertical faces of peds; 15 percent fine and very fine, angular, granitic gravel; medium acid (pH 6.0); gradual, wavy boundary.

C--56 to 60 inches, light reddish-brown (5YR 6/4) gravelly sandy loam, reddish brown (5YR 5/4) when moist; massive; very hard, very friable; 40 percent fine and very fine, angular, granitic gravel; medium acid (pH 6.0).

The A1 horizon ranges from 10 to 18 inches in thickness, and the A2 horizon ranges from 4 to 14 inches in thickness. The A horizon ranges from sandy loam to loamy sand in texture. The B2t horizon ranges from 10 to more than 30 inches in thickness and from sandy clay loam to clay loam in texture. Gravel content of the C horizon ranges from 15 to 40 percent.

Gove sandy loam, 5 to 20 percent slopes (GoE).--This sloping to moderately steep soil is on valley side slopes. Most mapped areas are less than 80 acres in size.

Included with this soil in mapping are small areas of Redridge, Chaseville, and Perrypark soils and a few small shale outcrops.

Runoff is medium to rapid. The hazard of erosion is moderate to high. In places gullies form in drainageways. This soil receives runoff from higher lying areas.

Most areas of this soil are in native grass and are used for grazing livestock. A few areas are cultivated and seeded to permanent grass. (Capability unit VIe-3; Sandy Foothill range site)

Gove-Shale outcrop complex, 5 to 65 percent slopes (GsF).--This strongly sloping to steep complex consists of about 50 percent Gove soils and about 20 percent shale outcrop. It is on valley side slopes. Shale outcrop is exposed areas of bedrock that have no vegetation.

Included in mapping are areas of a Gove-like soil that differs only in having a surface layer that is 1 to 3 inches thick. Weathered shale or sandstone bedrock is at a depth of 20 to 40 inches. In many places the soil is eroded and the sandy clay loam subsoil is exposed. This soil makes up about 20 percent of each mapped area. Also included are small areas of Satanta loam and Redridge-Chaseville gravelly sandy loams, 10 to 70 percent slopes. Taken together, these areas make up about 10 percent of each mapped area.

Runoff is medium to very rapid. The erosion hazard is moderate to high. Gulches are present in drainageways, especially adjacent to shale outcrop.

These areas are used for grazing livestock and for wildlife habitat. Gambel oak and mountain-mahogany are very common, and there are a few scattered ponderosa pine. (Capability unit VIe-2; Sandy Foothill range site)

Heldt Series

The Heldt series consists of well-drained soils that formed in fine-textured alluvial fan sediments derived primarily from sedimentary rock. These nearly level to gently sloping soils are on terrace fans along West Plum Creek. Slopes are 0 to 3 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 18 inches. Mean annual soil temperature is 48° to 51° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer and subsoil are grayish-brown clay about 24 inches thick. The underlying material is olive clay that extends to a depth of 60 inches or more.

Heldt soils have slow permeability. Available water capacity is high. Plant roots can penetrate to a depth of 60 inches or more.

Most areas of Heldt soils are in native grasses and are used for pasture and hay.

Representative profile of a Heldt clay, 600 feet north of the southwest corner of sec. 2, T. 9 S., R. 68 W.:

A1--0 to 5 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) when moist to dark grayish brown (2.5Y 4/2) when moist and crushed; moderate, fine, angular blocky structure; extremely hard, very firm; few slickensides; mildly alkaline (pH 7.8); clear, smooth boundary.

B2--5 to 24 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium and coarse, prismatic structure parting to moderate, medium, angular blocky; extremely hard, very firm; most roots confined to vertical faces of peds; slickensides and pressure faces common; strongly calcareous; moderately alkaline (pH 8.4); clear, smooth boundary.

C--24 to 60 inches, olive (5Y 5/3) clay, olive (5Y 4/3) when moist; massive; extremely hard when dry, very firm when moist; many slickensides; few gypsum and lime accumulations; strongly calcareous; moderately alkaline (pH 8.4).

Cracks are common and range from 1/2 to 2 inches in width and extend from 4 to 36 inches in depth when dry. The C horizon ranges from silty clay loam to clay in texture.

Heldt clay (0 to 3 percent slopes) (He).--This nearly level to gently sloping soil is on terrace fans on the western side of West Plum Creek near Dawson Butte. This is the only area of Heldt clay mapped in the Castle Rock Area.

Included with this soil in mapping are small areas of Englewood clay loam, Sampson loam, and Loamy alluvial land.

Runoff is slow. The hazard of erosion is slight to moderate. A few gullies form where water runs into West Plum Creek. Occasionally this soil is flooded with water from West Plum Creek, and it receives runoff from adjacent areas of Razor clay.

All areas of this soil are in native grass and are used for both hay and pasture. (Capability unit VIe-1; Clayey Foothill range site)

Hilly Gravelly Land

Hilly gravelly land (Hg) is in the warmer, northern part of the Area. Slopes are 5 to 50 percent. These areas are longer than they are wide, and most of them are more than 60 acres in size.

This land type is stratified. It contains 15 to 40 percent waterworn cobbles that are made up of quartz, quartzite, granite, and chalcedony. In most places the surface layer is a dark-colored cobbly sandy loam about 5 inches thick, but in some places it ranges from cobbly clay loam to cobbly loamy sand. The underlying material ranges from cobbly clay loam to gravelly sandy loam. Shale or partially consolidated gravelly material is between depths of 20 and 40 inches.

Included with this land in mapping are areas of Fondis-Kutch association and Newlin gravelly sandy loam, 8 to 30 percent slopes. Also included along drainageways are areas of Bresser-Truckton sandy loams, 5 to 25 percent slopes.

This land is well drained. Permeability is moderately slow, and available water capacity is low to moderate. Runoff is medium to rapid. The erosion hazard is moderate. Small slips on the steeper slopes expose interbedded shale and sandstone or gravel.

All of the acreage is in native vegetation that consists mainly of mountain-mahogany, squawbush, and grass. North-facing slopes have more brush than south-facing slopes. Livestock grazing and wildlife habitat are the main uses. (Capability unit VIIs-1; Cobbly Foothill range site)

Jarre Series

The Jarre series consists of well-drained soils that formed in alluvium derived from sandy sedimentary deposits. These sloping to steep soils are on upland side slopes and small knobs in the southern part of the Area. Slopes are 5 to 25 percent. The vegetation is mostly mid grasses, Gambel oak, and mountain-mahogany. Elevations are 6,600 to 7,800 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 43° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 3 inches thick, is grayish-brown loam. The subsoil is brown gravelly loam and gravelly sandy loam about 23 inches thick. The underlying material is light brownish-gray very gravelly sandy loam and very gravelly loamy sand extending to a depth of 60 inches or more.

Jarre soils have moderate permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Jarre soils are in native grasses and are used for grazing beef cattle and for wildlife habitat. They are also used as a source of material for road fill.

Representative profile of a Jarre loam, 1,320 feet west and 550 feet north of the southeast corner of sec. 32, T. 10 S., R. 65 W.:

A1--0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; 5 percent fine gravel; neutral (pH 6.8); clear, smooth boundary.

B1--3 to 6 inches, brown (7.5YR 5/3) heavy loam, dark brown (7.5YR 3/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; few, thin, patchy clay films on the vertical faces of peds; 10 percent gravel; neutral (pH 6.8); clear, smooth boundary.

B2t--6 to 19 inches, brown (7.5YR 5/4) gravelly heavy loam, brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; many, thin, patchy clay films on

both horizontal and vertical faces of peds; 20 percent fine gravel; neutral (pH 7.0); clear, smooth boundary.

B3--19 to 26 inches, brown (7.5YR 5/4) gravelly heavy sandy loam, dark brown (7.5YR 4/4) when moist; weak, coarse, subangular blocky structure; slightly hard, very friable; few thin clay coatings on sand grains; 25 percent gravel; neutral (pH 7.0); gradual, wavy boundary.

IIC1--26 to 33 inches, light brownish-gray (2.5Y 6/2) very gravelly loamy sand, grayish brown (2.5Y 5/2) when moist; massive; very hard, very friable; 60 percent gravel; neutral (pH 7.0); gradual, smooth boundary.

IIC2--33 to 60 inches, light brownish-gray (2.5Y 6/2) very gravelly sandy loam, grayish brown (2.5Y 5/2) when moist; massive; hard, very friable; 70 percent fine and very fine gravel; neutral (pH 7.0).

The A horizon ranges from 3 to 7 inches in thickness and from loam to gravelly sandy loam in texture. The B horizon ranges from 6 to 23 inches in thickness. Texture of the B2t horizon ranges from coarse sandy clay loam to gravelly loam or clay loam. Depth to the IIC horizon ranges from 20 to 40 inches. Most of the gravel is less than half an inch in diameter.

Jarre-Brussett association (5 to 25 percent slopes) (Jb).--This association is about 50 percent Jarre soils and about 35 percent Brussett soils. In a typical area, the Jarre soil is on knobs and steeper side slopes extending to drainageways and the Brussett soil is on ridgetops and less sloping areas, ordinarily on south-facing and east-facing slopes.

The Jarre soil has the profile described as representative for the series.

The Brussett soil has a profile similar to the one described as representative for the series, but the subsoil is 20 inches thick. Lime is at a depth of about 20 inches.

Runoff is rapid. Erosion is moderate to high.

Included with these soils in mapping are small areas of Loamy wet alluvial land, Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes, and Peyton sandy loam, 3 to 9 percent slopes. In a few places rock crops out at the head of drainageways. Taken together these areas make up about 15 percent of each mapped area.

These areas are in native grass and are used for grazing and for wildlife habitat. In places Gambel oak and mountain-mahogany are present. Gambel oak is more common on the Jarre soils. A few areas have been cultivated in the past, but are now planted to grass. (Capability unit VIe-3; Loamy Park range site)

Juget Series

The Juget series consists of shallow, somewhat excessively drained soils that formed in parent materials weathered residually from granite bedrock. These steep soils are on upland hills and ridges in the foothill and mountain areas. Slopes are 20 to 65 percent. The vegetation is mainly Douglas-fir and ponderosa pine, but south-facing slopes have scattered brush and grass. Elevations are 6,300 to 8,000 feet or more. Annual precipitation is 18 to 22 inches. Mean annual soil temperature is 42° to 46° F., and the frost-free season is less than 120 days.

In a representative profile the surface layer, about 9 inches thick, is dark grayish-brown and light-brown very gravelly light sandy loam and very gravelly loamy sand. The underlying material is pink very gravelly loamy sand. Pink granite is at a depth of about 15 inches.

Juget soils have rapid permeability. Available water capacity is low. Plant roots can penetrate to a depth of 20 inches or less.

All areas of Juget soils are in native vegetation and are used for wildlife habitat and limited grazing of livestock. The trees are used for firewood, Christmas trees, and poles and posts for fencing. These soils are a good source of material for road fill. Homesites are common on these soils.

Representative profile of a Juget very gravelly sandy loam, 1,300 feet east of the southwest corner of sec. 6, T. 8 S., R. 68 W.:

A1--0 to 4 inches, dark grayish-brown (10YR 4/2) very gravelly light sandy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 60 percent fine and very fine granitic gravel; slightly acid (pH 6.4); clear, smooth boundary.

AC--4 to 9 inches, light-brown (7.5YR 5/3) very gravelly loamy sand, dark brown (7.5YR 3/3) when moist; weak, coarse, subangular blocky structure; slightly hard, very friable; 70 to 80 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); clear, smooth boundary.

C--9 to 15 inches, pink (7.5YR 7/4) very gravelly loamy sand, brown (7.5YR 5/4) when moist; massive; soft, very friable; 80 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); abrupt, smooth boundary.

R--15 inches, hard, pink Pikes Peak granite.

The Juget series is fairly uniform throughout the survey area.

Juget rocky complex, 20 to 65 percent slopes (JuF).--This complex is an intricate mixture of about 70 percent Juget soils and about 15 percent Rock outcrop. This steep complex is on mountainous wooded lands in the western part of the Area. In most places areas are more than 200 acres in size.

Included in mapping are areas of Garber gravelly sandy loam, 5 to 30 percent slopes, that make up about 15 percent of each mapped area.

Runoff is rapid, and the erosion hazard is moderate. Soil slippage is common. Fire is a potential hazard.

Areas of this soil complex are used for grazing, wildlife habitat, and logging. These areas are a good source for Christmas trees and for material for road fill. (Capability unit VIIe-2; Stony loam range site)

Juget very rocky complex, 20 to 65 percent slopes (JvF).--This complex is an intricate mixture of about 60 percent Juget soils and about 30 percent rock outcrops of granite. This steep complex is on mountain slopes in the western part of the Area. In most places soil areas are 100 acres and more in size.

Included with these soils in mapping are areas of Garber gravelly sandy loam, 5 to 30 percent slopes, and a deep, dark-colored soil that is along drainageways. Taken together, these areas make up about 10 percent of each mapped area.

Runoff is rapid. The erosion hazard is moderate to high. Soil slippage is common.

Most areas of these soils are used for wildlife habitat and recreation, but some areas are logged for lumber. Gambel oak and mountain-mahogany are common vegetation, and where the area has been burned by fire, a few scattered grasses are present. In places Douglas-fir and ponderosa pine are present. (Capability unit VIIe-2)

Kassler Series

The Kassler series consists of somewhat excessively drained soils that formed in alluvium derived from arkosic sedimentary rock. These gently sloping soils are on terraces in the southwestern part of the Area. Slopes are 1 to 4 percent. The vegetation is mid and tall grasses, but in places there is some Gambel oak. Elevations are 6,500 to 7,000 feet. Annual precipitation is 15 to 20 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is less than 125 days.

In a representative profile the surface layer, about 28 inches thick, is dark reddish-brown and reddish-gray very gravelly sandy loam and very gravelly loamy sand. The underlying material is reddish-brown very gravelly loamy sand or very gravelly sand extending to a depth of 60 inches or more.

Kassler soils have rapid permeability. Available water capacity is low. In places low-lying areas are flooded. Plant roots can penetrate to a depth of 60 inches or more.

Most areas of Kassler soils are in native grasses and are used for grazing livestock. A few areas are irrigated and are used for pasture and hay.

Representative profile of a Kassler gravelly sandy loam, near the center of sec. 35, T. 9 S., R. 68 W.:

A11--0 to 6 inches, dark reddish-brown (5YR 3/2) gravelly sandy loam, dark reddish brown (5YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 30 percent fine and very fine granitic gravel; neutral (pH 6.8); clear, smooth boundary.

A12--6 to 20 inches, dark reddish-brown (5YR 3/2) very gravelly loamy sand, dark reddish brown (5YR 2/2) when moist; weak, medium to coarse, subangular blocky structure; hard, very friable; 60 percent fine and very fine granitic gravel; neutral (pH 6.8); gradual, smooth boundary.

A13--20 to 28 inches, reddish-gray (5YR 5/2) very gravelly loamy sand, dark reddish brown (5YR 3/2) when moist; weak, medium, granular structure; hard, loose; 70 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); gradual, wavy boundary.

C--28 to 60 inches, reddish-brown (5YR 5/3) very gravelly sand, reddish brown (5YR 4/3) when moist; single grain; loose when dry or moist; 70 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8).

The A horizon ranges from 20 to 30 inches in thickness and from gravelly or very gravelly sandy loam to very gravelly loamy sand in texture. The C horizon ranges from very gravelly loamy sand to very gravelly sand in texture. Gravel content in these soils is 50 to 70 percent.

Kassler gravelly sandy loam (1 to 4 percent slopes) (Ka).--This gently sloping soil is on the terraces of West Plum Creek and its tributaries in the southwestern part of the Area. Most mapped areas are long and narrow.

Included with this soil in mapping are small areas of Sandy alluvial land, Sandy wet alluvial land, and Garber gravelly sandy loam, 5 to 30 percent slopes.

Runoff is slow. The hazard of erosion is slight to moderate.

Most areas of this soil are in native grass and are used for grazing livestock. A few areas are irrigated and are used for pasture and hay. This soil is a good source for material for road fill. (Capability unit VIe-4, dryland; IVs-1, irrigated; Loamy Park range site)

Kettle Series

The Kettle series consists of somewhat excessively drained soils that formed in sandy alluvium that has been locally transported from, and in some places residual from, arkosic sedimentary rock. These sloping to moderately steep soils are on uplands in the southern part of the Area. Slopes are 5 to 25 percent. The vegetation is mostly ponderosa pine and some Douglas-fir, with an understory of mountain-mahogany, Gambel oak, and mid and tall grasses. Elevations are 6,600 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 45° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 3 inches thick is dark-gray loamy sand. The subsurface layer, about 14 inches thick, is gray loamy sand and white sand. The subsoil is very pale

brown coarse sand containing thin bands of brown and pale-brown sandy clay loam and sandy loam. The subsoil extends to a depth of 60 inches or more.

Kettle soils have moderately rapid permeability. Available water capacity is low. Plants can penetrate to a depth of 60 inches or more.

Most areas of Kettle soils are in native vegetation. They are used for logging of trees, limited grazing of livestock, wildlife habitat, recreation, homesites, and material for road fill.

Representative profile of a Kettle loamy sand, 550 feet west and 150 feet north of the southeast corner of sec. 34, T. 10 S., R. 66 W.:

O1--1 inch to 0, partially decomposed organic material consisting primarily of pine needles, twigs, and bark.

A1--0 to 3 inches, dark-gray (10YR 4/1) loamy sand, black (10YR 2/1) when moist; moderate, fine, granular structure; soft, very friable; 10 percent fine and very fine, angular, granitic gravel; medium acid (pH 5.8); clear, wavy boundary.

A21--3 to 9 inches, gray (10YR 6/1) loamy sand, dark gray (10YR 4/1) when moist; single grain; loose when dry or moist; 10 percent fine and very fine, angular, granitic gravel; medium acid (pH 5.6); clear, wavy boundary.

A22--9 to 17 inches, white (10YR 8/1) sand, light gray (10YR 7/2) when moist; single grain; loose when dry or moist; 15 percent fine and very fine, angular, granitic gravel; medium acid (pH 5.6); abrupt, wavy boundary.

B21t--17 to 26 inches, very pale brown (10YR 7/3) coarse loamy sand (composite texture), pale brown (10YR 6/3) when moist; this horizon consists of a matrix of coarse sand with 1/4 to 1 inch thick lamellae of brown (10YR 5/3) dry or moist, coarse sandy loam; moderate, medium to coarse, angular and subangular blocky structure; extremely hard, very friable; thin nearly continuous clay films on lamellae surfaces; 20 percent, fine and very fine, angular, granitic gravel; medium acid (pH 5.6); gradual, smooth boundary.

B22t--26 to 36 inches, very pale brown (10YR 7/3) coarse sandy loam (composite texture), pale brown (10YR 6/3) when moist; this horizon consists of a matrix of coarse sand with 1/2 to 2 inch thick lamellae of brown (10YR 5/3) dry or moist, sandy clay loam; moderate, medium, angular blocky structure; extremely hard, very friable; thin nearly continuous clay films on lamellae surfaces; 25 percent fine and very fine, angular, granitic gravel; medium acid (pH 6.0); diffuse, wavy boundary.

B3t--36 to 60 inches, very pale brown (10YR 7/3) coarse loamy sand (composite texture), pale brown (10YR 6/3) when moist; this horizon consists of a matrix of coarse sand with 1/4 to 3/4 inch thick lamellae of pale brown (10YR 6/3, moist or dry) coarse sandy loam, massive; very hard, very friable; few, thin, patchy clay films on lamellae surfaces; 25 percent fine and very fine, angular, granitic gravel; medium acid (pH 6.0).

The A1 horizon ranges from 2 to 6 inches in thickness, and the A2 horizon ranges from 3 to 30 inches in thickness. Texture of the A horizon ranges from sandy loam to sand. The B horizon ranges from 12 inches to more than 60 inches in thickness. The horizontal lamellae range from 1/4 to 6 inches in thickness, and the matrix material between lamellae ranges from 2 to 16 inches in thickness. In most places, the lamellae are thicker and closer together in the upper part of the subsoil than in the lower part.

Kettle loamy sand, 5 to 25 percent slopes (KeE).--This sloping to moderately steep soil is in wooded areas of the uplands in the southern part of the Area. Most mapped areas range from 45 to 600 acres in size.

Included with this soil in mapping are small areas of Crowfoot-Tomah sandy loams, 5 to 25 percent slopes, Pring gravelly sandy loam, and Larkson fine sandy loam, 3 to 9 percent slopes. Also included are rock outcrop and wet areas less than one-half acre in size. A few springs occur along the drainageways.

Runoff is slow to medium. The hazard of erosion is slight to moderate. Some gullies have formed in drainageways.

Some areas of this soil are used for grazing, and other areas are logged for lumber and fence poles and posts. Urban development is taking place in some areas. (Capability unit VIe-5)

Kettle-Falcon complex, 9 to 65 percent slopes (KfF).--This complex consists of an intricate mixture of about 50 percent Kettle soils and about 30 percent Falcon soils. In a typical area of these soils the Kettle soil is on upland hills and ridges and has slopes of less than 25 percent, and the Falcon soil is on steeper slopes along the edge of cliffs.

The Kettle soil has a profile similar to that described as representative for the series, but on the steeper slopes, the subsoil is thinner.

The Falcon soil has a profile similar to that described as representative for the series.

Included with these soils in mapping are small areas of Pring gravelly sandy loam, Rock outcrop that is mostly in the form of cliffs, and very narrow areas of a dark-colored soil along drainageways. Taken together, these areas make up about 20 percent of each mapped area.

Runoff is medium to rapid. The erosion hazard is slight to high. Tree-throw and soil slippage are common.

Areas of these soils are logged for lumber and fence posts and are used for wildlife habitat and recreation. Grazing is limited. (Capability unit VIIe-2)

Kippen Series

The Kippen series consists of somewhat excessively drained soils that formed in alluvium weathered

from arkosic sedimentary rock. These gently undulating to rolling soils are on alluvial fans and valley side slopes in the southern part of the Area. Slopes are 1 to 20 percent. The vegetation is mid and tall grasses. Elevations are 6,600 to 7,400 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 44° to 47° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer is dark grayish-brown and grayish-brown loamy sand about 24 inches thick. The underlying material is brown and light yellowish brown loamy sand and fine sand extending to a depth of 60 inches or more.

Kippen soils have rapid permeability. Available water capacity is low. Plants can penetrate to a depth of 60 inches or more.

Most areas of Kippen soils are in native grasses and are used for grazing livestock. A few areas have been cultivated, but most have been reseeded to grass or abandoned.

Representative profile of a Kippen loamy sand, 200 feet north of the center of sec. 25, T. 10 S., R. 66 W.:

A11--0 to 16 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure; soft, very friable; neutral (pH 6.6); clear, smooth boundary.

A12--16 to 24 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; very weak, coarse, prismatic structure; slightly hard, very friable; neutral (pH 6.6); gradual, smooth boundary.

AC--24 to 32 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; single grain; loose when dry and moist; neutral (pH 6.6); gradual, wavy boundary.

C--32 to 60 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; single grain; loose when dry and moist; neutral (pH 6.6).

The A horizon ranges from 20 to 32 inches in thickness and from gravelly sandy loam to sand in texture. The C horizon extends to a depth of 40 inches or more and in texture ranges from sand to loamy sand. In places gravel is below a depth of 40 inches.

Kippen loamy sand, 1 to 20 percent slopes (KnE).--This gently undulating to rolling soil is on alluvial fans and valley side slopes in the southern part of the Area. Most mapped areas are more than 40 acres in size.

Included with this soil in mapping are small areas of Pring gravelly sandy loam that are small knobs, Crowfoot-Tomah sandy loams, 5 to 25 percent slopes, and Cruckton sandy loam, 1 to 9 percent slopes.

Runoff is slow to medium. The hazard of erosion is slight to moderate. Some gullies are on drainageways. The surface crusts where the soil is cultivated.

Most areas of this soil are used for grazing livestock. A few small areas have been cultivated in the past, but most of these areas have been seeded to grass. (Capability unit VIe-4; Sandy Divide range site)

Kippen and Pring soils, 1 to 12 percent slopes, eroded (KpD2).--This undifferentiated soil group is made up of Kippen and Pring soils. In a typical area of these soils, both soils are present, but in places only one of them is. In most places the Kippen soil areas are larger than the Pring. These gently undulating to rolling soils are on alluvial fans and valley side slopes in the southeastern part of the Area. In most places soil areas are larger than 40 acres in size.

The Kippen soil has a profile similar to the one described as representative for the series, but about 40 percent of soil area has a surface layer of brown loamy sand or sand 6 inches or less in thickness.

The Pring soil has a profile similar to the one described as representative for the series, but as a result of erosion about half of the soil has a dark-colored surface layer 4 to 7 inches thick.

Included with these soils in mapping are small areas of Crowfoot-Tomah sandy loams, 5 to 25 percent slopes, and Peyton sandy loam, 1 to 3 percent slopes. Also included are small areas of soils accumulated by soil blowing or water runoff.

Runoff is medium to rapid. Surface crusting is common. The erosion hazard is moderate to high and gullies 1 to 6 feet deep at intervals of 200 feet are common.

Most areas of these soils are abandoned cultivated fields, but some areas have been reseeded to grass. Where a seed source of older trees is nearby, ponderosa pines is common. (Capability unit VIe-4; Sandy Divide range site)

Kutch Series

The Kutch series consists of moderately deep, well-drained soils that formed in fine-textured, calcareous material weathered from clay shale. These gently sloping to moderately steep soils are on uplands in the northern part of the Area. Slopes are 4 to 20 percent. The vegetation is mainly short and mid grasses, but some areas support ponderosa pine. Elevations are 5,500 to 6,800 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile, the surface layer is grayish-brown clay loam about 3 inches thick. The subsoil, about 16 inches thick, is grayish-brown to light yellowish-brown clay. The underlying material is a light yellowish-brown clay loam. Soft shale is at a depth of about 32 inches.

Kutch soils have slow permeability. Available water capacity is moderate. Plant roots penetrate to the shale.

Most areas of this soil are in native grasses and are used for grazing livestock. Some areas are used for woodland products, and a few areas are used for growing wheat.

Representative profile of a Kutch clay loam at the northeast corner of sec. 21, T. 9 S., R. 65 W.:

A1--0 to 3 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; soft, friable; neutral (pH 7.2); clear, smooth boundary.

B1--3 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure parting to strong, fine, angular blocky; hard, firm; thin patchy clay film on vertical faces of peds; neutral (pH 7.2); clear, smooth boundary.

B2t--6 to 13 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure parting to strong, medium to fine, angular blocky; very hard, firm; thin nearly continuous clay films on both vertical and horizontal faces of peds; mildly alkaline (pH 7.4); clear, smooth boundary.

B3--13 to 19 inches, light yellowish-brown (2.5Y 6/3) clay, olive brown (2.5Y 5/3) when moist; moderate, medium, prismatic structure; parting to moderate, medium, subangular blocky; very hard, firm; few, thin, patchy clay films on vertical faces of peds; strongly calcareous; moderately alkaline (pH 8.2); clear, smooth boundary.

Cca--19 to 32 inches, light yellowish-brown (10YR 6/3) clay loam, light olive brown (10YR 5/3) when moist; weak, medium to coarse, prismatic structure; hard, friable; strongly calcareous with few, medium, distinct lime concretions; moderately alkaline (pH 8.4); gradual, smooth boundary.

R--32 to 48 inches, light yellowish-brown (2.5Y 6/3) soft shale that weathers to clay loam (2.5Y 5/3) when moist.

The A horizon ranges from 3 to 9 inches in thickness and from sandy loam to clay loam in texture. The B horizon ranges from 6 to 30 inches in thickness. Depth to lime ranges from 10 to 36 inches. Weathered shale or siltstone is at a depth of 20 to 40 inches.

Kutch sandy loam, 5 to 20 percent slopes (KtE).--This strongly sloping to moderately steep soil is on alluvial fans and valley side slopes that are below rock cliffs and below stony steep land along major drainageways. Most mapped areas are more than 100 acres in size.

This soil has a profile similar to that described as representative for the series, except that the surface layer is a sandy loam about 7 inches thick. In places shale is at depths of 20 to 30 inches.

Included with this soil in mapping are small areas of Newlin gravelly sandy loam, 8 to 30 percent slopes, and small areas of Bresser sandy loam, 3 to 9 percent slopes, along drainageways.

Runoff is rapid. The hazard of erosion is moderate. Drainageways are close together and in many places gullied to a depth of more than 1 foot.

Areas of this soil are used for grazing livestock. (Capability unit VIe-1; Sandy Foothill range site)

Kutch clay loam, 4 to 8 percent slopes (KuD).--This sloping soil is on uplands, mainly in the northern part of the Area. Most mapped areas are long and irregularly shaped and more than 40 acres in size.

Included with this soil in mapping are small areas of Fondis clay loam, 3 to 9 percent slopes. Also included are areas of Loamy alluvial land along drainageways. In places there are small rock outcrops.

Runoff is medium. The erosion hazard is slight to moderate. Some gullies have formed along drainageways.

About 60 percent of the acreage is used for grazing livestock. The remaining area is cultivated and is used for growing dryland wheat. A few cultivated areas have been reseeded to grass. (Capability unit IVe-3; Clayey Foothill range site)

Kutch clay loam, 8 to 20 percent slopes (KuE).--This moderately steep soil is on valley side slopes. Most mapped areas are 10 to 40 acres in size.

This soil has a profile similar to that described as representative for the series, except that the dark color extends to depths of 6 to 9 inches. Lime is below a depth of 20 inches.

Included with this soil in mapping are small areas of Fondis clay loam, 3 to 9 percent slopes, and some small knobs of Newlin gravelly sandy loam, 8 to 30 percent slopes.

Runoff is rapid. The erosion hazard is moderate. Some gullying has taken place in drainageways. Slips 6 to 12 inches high are present.

Areas of this soil are used for grazing livestock. (Capability unit VIe-1; Clayey Foothill range site)

Kutch-Newlin-Stapleton complex, 8 to 40 percent slopes (KwF).--This complex is about 35 percent Kutch soils, about 25 percent Newlin soils, and about 25 percent Stapleton soils. Kutch soils are at the highest elevations and extend part way down the slope. Newlin soils are directly below Kutch soils, and Stapleton soils are at the lowest elevations and on small knobs.

Included with these soils in mapping are small areas of cobbly knobs, Fondis soils, Loamy alluvial land, and Larkson fine sandy loam, 3 to 9 percent slopes, on north-facing slopes. Taken together, these make up 15 percent of each mapped area.

Runoff is rapid. The erosion hazard is moderate. Gullies are common along drainageways.

Most areas of these soils are used for grazing livestock and some areas are used for wildlife habitat. Ponderosa pine and a good understory of Gambel oak and mountain-mahogany are common. Mid and tall grasses are also present. Urban development has taken place in some areas. (Capability unit VIe-5)

Larkson Series

The Larkson series consists of well-drained soils that formed in materials that weathered in place or that were transported from soft sedimentary deposits nearby. These gently sloping to sloping soils are on upland hills and ridges in the southern part of the Area. Slopes are 3 to 9 percent. The vegetation is mainly ponderosa pine and a few Douglas-fir trees, with an understory of Gambel oak and grass. Elevations are 7,000 to 8,000 feet. Annual precipitation is 17 to 19 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 115 to 120 days.

In a representative profile the surface layer, about 4 inches thick, is dark grayish-brown fine sandy loam. It overlies a subsurface layer of pale-brown loam about 14 inches thick. The subsoil to a depth of 54 inches or more is brown and grayish-brown clay and clay loam.

Larkson soils have slow permeability. Available water capacity is high. Plants can penetrate to a depth of 40 inches or more.

All areas of Larkson soils are in native vegetation and are used for grazing livestock, for wildlife habitat, and for recreation.

Representative profile of a Larkson fine sandy loam, 200 feet north and 1,900 feet east of the southwest corner of sec. 14, T. 9 S., R. 67 W.:

O1--1 inch to 0, partially decomposed organic material consisting mainly of pine needles, twigs, leaves, and bark.

A1--0 to 4 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; slightly hard, friable; slightly acid (pH 6.2); clear, smooth boundary.

A21--4 to 9 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 3/3) when moist; very weak, coarse prismatic structure; slightly hard, friable; slightly acid (pH 6.2); clear, smooth boundary.

A22--9 to 13 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; hard, friable; slightly acid (pH 6.4); clear, smooth boundary.

A&B--13 to 18 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard, friable; nodules and seams of clayey material like that of the underlying horizon in a lighter colored matrix like that of the overlying horizon; slightly acid (pH 6.4); gradual, wavy boundary.

B2t--18 to 30 inches, brown (7.5YR 5/4) clay, brown or dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, fine, angular blocky; extremely hard, very firm; thin continuous clay films on horizontal and vertical faces of peds; few slickensides; neutral (pH 7.0); gradual, wavy boundary.

B3--30 to 53 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm, thin nearly continuous clay films on horizontal and vertical faces of peds; few slickensides; neutral (pH 7.2).

The dark-colored A1 horizon ranges from 0 to 4 inches in thickness and from loam to loamy sand in texture. The light-colored A2 horizon ranges from 4 to 20 inches in thickness and from loam to loamy sand in texture. The B2t horizon ranges from 10 to 36 inches or more in thickness. In places lime or shale is at a depth of more than 40 inches.

Larkson fine sandy loam, 3 to 9 percent slopes (LaD).--This gently sloping to sloping soil is in wooded areas in the southern part of the Area. Most mapped areas are small.

Included with this soil in mapping are small areas of Brussett loam, 3 to 9 percent slopes, and Kettle loamy sand, 5 to 25 percent slopes. A few rocks outcrop.

Runoff is medium. The erosion hazard is slight. In most places the bottoms of drainageways are exposed rock.

Areas of this soil are mainly used for livestock grazing, woodland products, wildlife habitat, and recreation. (Capability unit VIe-5)

Loamy Alluvial Land

Loamy alluvial land (Lo) is in swales or on flood plains in the northern part of the Area. Slopes are 1 to 5 percent. These areas are long and narrow, and most of them are less than 40 acres in size.

This highly stratified land type is dark colored to a depth of 30 inches or more. To a depth of 20 inches this land is sandy loam to clay loam in texture. Below that it is loamy sand to clay loam. A few gullies 4 to 20 feet deep are in areas once cultivated.

Included with this land in mapping are small areas of Sampson loam, Bresser sandy loam, 1 to 3 percent slopes, and Sandy alluvial land.

This land is well drained. Permeability is moderate, and available water capacity is moderate to high. Runoff is medium. The erosion hazard is moderate to high. This land is flooded, usually every year, or at least once every 3 to 5 years. Effective rooting depth is more than 60 inches. This land has no beneficial seasonal high water table.

All of the acreage is in native grass and is used for grazing livestock. (Capability unit VIw-1; Overflow range site)

Loamy Alluvial Land, Dark Surface

Loamy alluvial land, dark surface (Lu) is in swales or on flood plains in the northern part of the Area. Slopes are 0 to 4 percent. These areas are long and narrow, and most of them are less than 60 acres in size.

The surface layer is stratified and is a dark-colored sandy loam or loam about 7 to 20 inches thick. The underlying material to a depth of 30 inches or more is stratified sandy loam, loam, and clay loam. In the vicinity of the South Platte River, sand and gravel are below a depth of 30 inches.

Included with this land in mapping are areas of poorly drained Sandy alluvial land, soils with clayey texture, small wet areas, and stream channels.

Most of this land is well drained, but some areas are somewhat poorly drained. Surface runoff is slow to medium. The erosion hazard is slight to moderate. This land receives water runoff from adjacent areas, and it is flooded during storms. A water table is not common, except along the South Platte River, where it is at a depth of less than 2 feet during some seasons. A live stream ordinarily runs through areas of this land.

Almost all of the acreage is in meadow, pasture, or alfalfa. Some irrigation is used. Below a depth of 30 inches areas along the South Platte River are an excellent source of gravel. (Capability unit IVw-1; Loamy Foothill range site)

Loamy Wet Alluvial Land

Loamy wet alluvial land (Lw) is in swales and on creek bottoms in the southern part of the Area. Slopes are 1 to 5 percent. These areas are long and narrow.

This land type is stratified. The surface layer is a sandy loam to light clay loam about 20 inches thick. The underlying material ranges from clay to sand in texture and ordinarily is stratified.

Included with this land in mapping are areas of Sandy wet alluvial land. Creek channels, small springs, and marsh areas are also included.

This land is poorly drained. Permeability is moderately slow, and available water capacity is moderate to high. Runoff is slow. The erosion hazard is slight where vegetation is permanent, but it is high where the land is bare as a result of flooding. This land ordinarily is flooded once a year, and not less than once in 5 years. The seasonal high water table is at a depth of less than 5 feet, and it may be at the surface in spring. Live springs are near the bottom of the slope in some swales.

Most of the acreage is in meadow and is used for hay and pasture. It is not suitable for cultivation. (Capability unit Vw-1; Mountain Meadow range site)

Lonetree Series

The Lonetree series consists of somewhat excessively drained soils that formed in alluvium derived from weathered, reddish-brown, arkosic sedimentary rock. These sloping to steep soils are on valley sides in the southwestern part of the Area. The vegetation is mid and tall grasses. Elevations are 6,000 to 6,800 feet. Annual precipitation is 17 to 19 inches. Mean annual soil temperature is 45° to 47° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer is dark reddish-brown and reddish-brown loamy sand about 18 inches thick. The underlying material is reddish-brown and red sand and loamy sand extending to a depth of 60 inches or more.

Lonetree soils have rapid permeability. Available water capacity is low. Plants can penetrate to a depth of 60 inches or more.

Most areas of Lonetree soils are in native grasses and are used for grazing livestock. A few areas have been cultivated, but most are reseeded to permanent grasses. These soils are used as a source of material for road fill.

The Lonetree soils in the Area are mapped in complexes with Redtom soils and Rock land. These mapping units are described under the headings "Redtom Series" and "Rock Land."

Representative profile of a Lonetree loamy sand, 1,320 feet south and 300 feet east of the northwest corner of sec. 25, T. 9 S., R. 68 W.:

A11--0 to 6 inches, dark reddish-gray (5YR 4/2) loamy sand, dark reddish brown (5YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; neutral (pH 6.6); clear, smooth boundary.

A12--6 to 18 inches, reddish-brown (5YR 5/3) loamy sand, dark reddish brown (5YR 3/3) when moist; weak, coarse, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; neutral (pH 6.6); clear, smooth boundary.

AC--18 to 24 inches, reddish-brown (2.5YR 5/4) loamy sand, reddish brown (2.5YR 4/4) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; very hard, very friable; neutral (pH 6.8); gradual, wavy boundary.

C--24 to 60 inches, weak-red (10R 5/4) sand, weak red (10R 4/4) when moist; single grain; loose when dry and moist; neutral (pH 6.8).

The A horizon ranges from 6 to 20 inches in thickness and from light sandy loam to loamy sand in texture.

Louviers Series

The Louviers series consists of shallow, well-drained soils that formed in materials that weathered from underlying noncalcareous shale. These soils are most commonly along the Plum Creek drainageway. Slopes range from 7 to 30 percent. The vegetation is short and mid grasses. Elevations are 5,800 to 6,500 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 49° to 52° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 4 inches thick, is grayish-brown clay. The underlying material is grayish-brown clay that rests

on light olive-brown, noncalcareous clay shale at a depth of 12 inches.

Louviers soils have slow permeability. Available water capacity is low. Plants can penetrate to a depth of 10 to 20 inches.

All areas of Louviers soils are in native grasses and are used for grazing livestock.

The Louviers soils in the Area are mapped only in a complex with Bresser soils. This mapping unit is described under the heading "Bresser Series."

Representative profile of a Louviers clay, 400 feet west of the northeast corner of the northwest quarter of sec. 30, T. 7 S., R. 67 W.:

A1--0 to 4 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; strong, very fine, granular structure; slightly hard, friable; neutral (pH 6.8); clear, smooth boundary.

C--4 to 12 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; massive or very weak, coarse, angular blocky structure; extremely hard, firm; neutral (pH 6.8); gradual, wavy boundary.

R--12 inches, light olive-brown (2.5Y 5/3) noncalcareous clay shale.

The A1 horizon ranges from 2 to 5 inches in thickness and from clay loam to clay in texture. The C horizon ranges from 6 to 15 inches in thickness. Depth to shale ranges from 10 to 20 inches. A few pebbles are on the surface.

Manzanola Series

The Manzanola series consists of well-drained soils that formed in alluvial materials derived from sedimentary rock or eolian deposits. These sloping soils are on uplands in the northern part of the Area. Slopes are 3 to 6 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,200 feet. Annual precipitation is 15 to 17 inches. Mean annual soil temperature is 49° to 54° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer is light brownish-gray clay loam about 5 inches thick. The upper part of the subsoil, about 39 inches thick, is light brownish-gray and brown clay loam. The lower part of the subsoil is brown clay loam that contains gypsum concretions and extends to a depth of 60 inches or more. In places shale is below a depth of 40 inches.

Manzanola soils have slow permeability. Available water capacity is high. Plants can penetrate to a depth of 40 inches or more.

About 60 percent of Manzanola soil areas are in native pasture and are used for grazing livestock. The remaining 40 percent is used to grow small grains, mainly wheat and some forage sorghum.

Representative profile of Manzanola clay loam, 1,320 feet north and 1,920 feet west of the southeast corner of sec. 20, T. 6 S., R. 66 W.:

Ap--0 to 5 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; moderate, granular structure; hard, friable; strongly calcareous; moderately alkaline (pH 8.0); abrupt, smooth boundary.

B1--5 to 8 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium and fine, subangular blocky structure; very hard, very firm; few, thin, nearly continuous clay films on faces of peds; strongly calcareous; moderately alkaline (pH 8.0); clear, smooth boundary.

B21t--8 to 25 inches, brown (10YR 5/3) clay loam, brown or dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate and strong, fine, angular blocky; very hard, very firm; thin nearly continuous clay films on faces of peds; slickensides common; strongly calcareous with few lime nodules; moderately alkaline (pH 8.2); clear, smooth boundary.

B22--25 to 44 inches, brown (10YR 5/3) clay loam, brown or dark brown (10YR 4/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; few, thin, patchy clay films on faces of peds; few slickensides; strongly calcareous; moderately alkaline (pH 8.2); clear, smooth boundary.

IIB23cs--44 to 60 inches, brown (10YR 5/3) light clay loam, brown or dark brown (10YR 4/3) when moist; weak, medium, prismatic structure; hard, friable; thin patchy clay films on faces of peds; common, medium, distinct gypsum concretions; strongly calcareous; moderately alkaline (pH 8.0); shale is below a depth of 72 inches.

The A horizon ranges from 2 to 8 inches in thickness and from heavy loam to clay loam in texture. The B horizon ranges from 10 to 60 inches in thickness. In a few places buried soils are below a depth of 40 inches. Shale is at a depth of more than 40 inches. In a few places lime and gypsum concretions are present.

Manzanola clay loam (3 to 6 percent slopes) (Ma).--This sloping soil is on uplands in the extreme northern part of the Area. Most mapped areas are long and irregularly shaped, and in most places they are more than 60 acres in size.

Included with this soil in mapping are small areas of Renohill clay loam that is at the lower end of slopes, small areas of Buick-Satanta loams, 3 to 9 percent slopes, and Fondis clay loam, 3 to 9 percent slopes. Also included are a few knobs of Newlin gravelly sandy loam, 8 to 30 percent slopes, that are less than 1 acre in size.

Runoff is medium to rapid. The erosion hazard is moderate. Rills form after heavy rain, and there is some gullying in drainageways. Plowpans form easily and restrict the rate of water intake and plant root development.

More than half of the acreage is cultivated and is used to grow small grain, mainly wheat and some sorghum for hay. The rest of the acreage is in native pasture and is used for grazing livestock. (Capability unit IVe-3; Clayey Foothill range site)

Newlin Series

The Newlin series consists of well-drained soils. These soils formed in alluvial soil materials derived from mixed sources and are moderately deep over unconformable very gravelly sand. They are rolling to moderately steep soils on uplands and side slopes. Slopes are 8 to 30 percent. The vegetation is mainly mid and tall grasses, but in places mountain-mahogany, Gambel oak, and squawbush are present. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 49° to 51° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer is dark grayish-brown gravelly sandy loam about 8 inches thick. The subsoil, about 14 inches thick, is brown and light-brown gravelly sandy clay loam and gravelly sandy loam. The underlying material is brownish-yellow very gravelly sand that extends to a depth of 60 inches or more.

Newlin soils have moderate permeability. Available water capacity is low. Plants penetrate to a depth of 60 inches or more.

Most areas of Newlin soils are in native grasses and are used for grazing livestock and for wildlife habitat. Where gravel beds are thick, these soils are sources of gravel for construction.

Representative profile of a Newlin gravelly sandy loam, 400 feet east and 400 feet south of the northwest corner of sec. 30, T. 7 S., R. 67 W.:

A1--0 to 8 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; soft, very friable; 25 percent gravel; neutral (pH 6.8); clear, smooth boundary.

B2t--8 to 17 inches, brown (7.5YR 5/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, friable; many, thin, patchy clay films on horizontal and vertical faces of peds; 25 percent gravel; neutral (pH 6.8); clear, smooth boundary.

B3--17 to 22 inches, light-brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) when moist; weak, coarse, prismatic structure; hard, friable; few patchy clay films on faces of peds; 35 percent gravel; neutral (pH 6.8); clear, wavy boundary.

IIC--22 to 60 inches, brownish-yellow (10YR 6/6) very gravelly sand, yellowish brown (10YR 6/6) when moist; single grain; loose when dry and moist; 50 percent gravel; neutral (pH 7.0).

The A horizon ranges from 3 to 10 inches in thickness and from gravelly sandy loam to gravelly loamy sand in texture. The B2t horizon ranges from 6 to 24 inches in thickness and from gravelly sandy clay loam to gravelly clay loam in texture. Gravel content of the B horizon ranges from 15 to 50 percent, but the average is less than 35 percent. Sand and gravel are at a depth of 20 to 40 inches. Gravel content of the C horizon ranges from 35 to 60 percent. In places sandstone or shale is below a depth of 40 inches.

Newlin gravelly sandy loam, 8 to 30 percent slopes (NeE).--This rolling to steep soil is on uplands and terrace side slopes in the northern part of the area. Most mapped areas are more than 100 acres in size. A few small areas are next to stream channels.

Included with this soil in mapping are small areas of Bresser sandy loam, 3 to 9 percent slopes, that are on the lower part of slopes adjacent to drainageways and that make up about 20 percent of each mapped area. Also included are areas of Stapleton loamy sand, 6 to 30 percent slopes, that are on knobs and points seldom exceeding 2 acres in size, and small areas of Satanta loam on the highest, smoothest part of the landscape.

Runoff is medium. The erosion hazard is slight to moderate.

Most areas of this soil are used for grazing livestock. Wildlife habitat is important in places. (Capability unit VIe-2; Gravelly Foothill range site)

Newlin-Satanta complex, 5 to 20 percent slopes (NsE).--This complex is an intricate mixture of about 50 percent Newlin soils and about 30 percent Satanta soils. In most places Newlin soils are on knobs and side slopes leading down to drainageways and Satanta soils are at higher elevations than Newlin soils.

The Newlin soil has a profile similar to that described as representative of the series.

The Satanta soil has a profile similar to the one described as representative for the series, but the surface layer is about 6 inches thick and the subsoil is about 20 inches thick. Depth to lime ranges from 8 to 24 inches.

Included with these soils in mapping are small areas of Buick loam, Bresser sandy loam, 3 to 9 percent slopes, Truckton sandy loam, 3 to 8 percent slopes, and a sandy soil that is similar to Newlin soils except that it contains less gravel and has a layer of lime. Taken together, these areas make up about 20 percent of each mapped area.

Runoff is medium. The erosion hazard is slight. Soil slippage takes place in areas that have slopes exceeding 15 percent.

Most areas of these soils are in native grass and are used for grazing livestock and wildlife habitat. Brush, ponderosa pine, and juniper are present. In places these are source areas for gravel. (Newlin series: capability unit VIe-2; Gravelly Foothill range site. Satanta series: capability unit VIe-2; Loamy Foothill range site)

Orsa Series

The Orsa series consists of somewhat excessively drained soils that formed in alluvium from arkosic sedimentary rock. The nearly level to gently sloping soils are on alluvial fans. Slopes are 1 to 4 percent. The vegetation is mid and tall grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 27 inches thick, is dark grayish-brown and grayish-brown coarse sandy loam and gravelly coarse loamy sand. The underlying material is pale-brown gravelly coarse sand extending to a depth of 60 inches or more.

Orsa soils have rapid permeability. Available water capacity is low. Plants can penetrate to a depth of 60 inches or more.

Most areas of Orsa soils are in native grasses and are used for grazing livestock. Small areas are cultivated to dryland grain or are irrigated and producing alfalfa.

The Orsa soils in the Area are mapped only in an association with Blakeland soils. This mapping unit is described under the heading "Blakeland Series."

Representative profile of an Orsa coarse sandy loam, 1,300 feet north and 500 feet west of the southeast corner of sec. 12, T. 8 S., R. 68 W.:

A11--0 to 8 inches, dark grayish-brown (10YR 4/2) coarse sandy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 5 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); gradual, smooth boundary.

A12--8 to 20 inches, dark grayish-brown (10YR 4/2) light coarse sandy loam, very dark brown (10YR 2/2) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, very friable; 10 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); gradual, smooth boundary.

A13--20 to 27 inches, grayish-brown (10YR 5/2) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; very weak, medium, subangular blocky structure; hard, very friable; 15 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); gradual, smooth boundary.

C--27 to 60 inches, pale-brown (10YR 6/3) gravelly coarse loamy sand, brown (10YR 5/3) when moist; single grain; loose when dry or moist; 30 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8).

The Orsa soils are uniform throughout the survey area, but they vary slightly in texture of the C horizon, which ranges from gravelly loamy coarse sand to gravelly coarse sand. In places the dark-colored surface layer is more than 20 inches thick.

Perrypark Series

The Perrypark series consists of well-drained soils that formed in alluvium from reddish-brown arkosic sedimentary rock. These gently sloping to moderately steep soils are on alluvial fans and valley side slopes. Slopes are 3 to 20 percent. The vegetation is mid and tall grasses. Elevations are 6,000 to 7,000 feet. Annual precipitation is 17 to 19 inches. Mean annual soil temperature is 45° to 47° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer is dark reddish-gray sandy loam about 7 inches thick. The subsoil, about 43 inches thick, is dark reddish-gray and reddish-brown sandy clay loam and heavy sandy loam. The underlying material is light reddish-brown sandy loam extending to a depth of 60 inches or more.

Perrypark soils have moderate permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Perrypark soils are in native grasses and are used for grazing livestock. A few areas have been cultivated, but most have been reseeded to grass. Urban development has taken place in some areas.

Representative profile of a Perrypark sandy loam, 800 feet south and 400 feet east of the northwest corner of the southwest quarter of sec. 31, T. 9 S. R. 67 W.:

A1--0 to 7 inches, dark reddish-gray (5YR 4/2) sandy loam, dark reddish brown (5YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 5 percent fine, angular, granitic gravel; neutral (pH 6.8); clear, smooth boundary.

B1--7 to 12 inches, dark reddish-gray (5YR 4/2) heavy sandy loam, dark reddish brown (5YR 2/2) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; few, thin, patchy clay films principally on vertical faces of peds; 5 percent gravel; neutral (pH 6.8); clear, smooth boundary.

B2t--12 to 36 inches, reddish-brown (2.5YR 5/4) sandy clay loam, reddish brown (2.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium and fine, subangular blocky; extremely hard, very friable; thin nearly continuous clay films on faces of peds; 5 percent gravel; neutral (pH 6.8); clear, smooth boundary.

B3--36 to 50 inches, reddish-brown (2.5YR 5/4) heavy sandy loam, reddish brown (2.5YR 4/4) when moist; weak, medium, subangular blocky structure; extremely hard, very friable; few, thin, patchy clay films on faces of peds; 5 percent gravel; neutral (pH 6.8); gradual, wavy boundary.

C--50 to 60 inches, light reddish-brown (2.5YR 6/4) sandy loam, reddish brown (2.5YR 5/4) when moist; massive; extremely hard, very friable; 5 percent gravel; neutral (pH 6.8).

The A horizon ranges from 6 to 18 inches in thickness. Gravel content is 0 to 20 percent. The B2t horizon ranges from 12 to 36 inches in thickness and from heavy sandy loam to sandy clay loam in texture. The C horizon ranges from sandy loam to loamy sand in texture.

Perrypark sandy loam, 3 to 20 percent slopes (PdE).--This gently sloping to moderately steep soil is in the southwestern part of the Area. Most mapped areas are more than 40 acres in size and are irregularly shaped.

Included with this soil in mapping are small areas of Cheeseman loam and Redtom sandy loam. Also included are areas of Lonetree loamy sand on the steeper slopes.

Runoff is medium to rapid. The erosion hazard is moderate. Some gullies are present in cultivated fields. Soil slippage takes place on slopes of more than 9 percent.

Most areas of this soil are used for grazing livestock. A few areas have been cultivated, but most have been reseeded to grass. (Capability unit VIe-3; Sandy Divide range site)

Peyton Series

The Peyton series consists of well-drained soils that formed in alluvium derived from weathered arkosic sedimentary rock. These gently sloping to moderately steep soils are on upland ridges, alluvial fans, and valley side slopes. Slopes are 1 to 15 percent. The vegetation is mainly mid and tall grasses, but in places Gambel oak and mountain-mahogany are present. Elevations are 6,500 to 8,000 feet. Annual precipitation is 15 to 18 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 115 to 120 days.

In a representative profile the surface layer, about 11 inches thick, is dark grayish-brown sandy loam. The subsoil is grayish-brown, brown, and pale-brown sandy clay loam and sandy loam about 29 inches thick. The underlying material is pale-brown sandy loam extending to a depth of 60 inches or more.

Peyton soils have moderate permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Peyton soils are in native grasses and are used for grazing livestock. Some areas are cultivated and are used to grow dryfarmed crops. Wildlife habitat occurs in places, and urban development is taking place in some areas.

Representative profile of a Peyton sandy loam, 150 feet west and 550 feet north of the southeast corner of sec. 29, T. 10 S., R. 65 W.:

A1--0 to 6 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard, very friable; neutral (pH 6.6); clear, smooth boundary.

A3--6 to 11 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; neutral (pH 6.6); clear, smooth boundary.

B21t--11 to 15 inches, grayish-brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, very friable; thin nearly continuous clay films on faces of peds; neutral (pH 6.6); clear, smooth boundary.

B22t--15 to 30 inches, brown (10YR 5/3) sandy clay loam, brown (10YR 5/3) or dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, very friable; thin nearly continuous clay films on faces of peds; neutral (pH 6.6); gradual, smooth boundary.

B3--30 to 40 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; extremely hard, very friable; few, thin, patchy clay films on faces of peds; neutral (pH 6.6); gradual, smooth boundary.

C--40 to 60 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; massive; extremely hard, very friable; neutral (pH 6.6).

The A horizon ranges from 5 to 20 inches in thickness. The lower part of the A horizon ranges from loamy sand to sandy loam and in places has a layer of gray 1 to 2 inches thick. The B horizon ranges from 10 to 40 inches in thickness. Gravel content is 0 to 15 percent. The C horizon ranges from sandy loam to coarse sand in texture. Hard, resistant material is below a depth of 40 inches or more.

Peyton sandy loam, 1 to 3 percent slopes (PeB).--This gently sloping to gently undulating soil is on the tablelands in the southern part of the Area. Most mapped areas are less than 8 acres in size.

Included with this soil in mapping are small areas of Pring gravelly loam, Brussett loam, 1 to 3 percent slopes, and Jarre soils. Also included are a few wet-weather lakes less than 1 acre in size.

Runoff is slow. The erosion hazard is slight. Some gullies are present in cultivated fields.

Most areas of this soil are in native grass and are used for grazing livestock. A few areas are cultivated and are used to grow dryland crops, mainly wheat and oats. Wildlife habitat is important in places. (Capability unit IIIc-1; Sandy Divide range site)

Peyton sandy loam, 3 to 9 percent slopes (PeD).--This sloping soil is on tablelands and side slopes in the southern part of the Area. Most mapped areas are more than 40 acres in size and are long and irregularly shaped.

Included with this soil in mapping are small areas of Jarre soils on small knobs and ridges, small areas of Pring gravelly sandy loam along drainageways, and a few areas of Brussett loam, 3 to 9 percent slopes.

Runoff is usually medium, but during spring snowmelt runoff is rapid. The erosion hazard is moderate. Rills and gullies are common (plate V, bottom).

About half of the acreage is in native grass and used for grazing livestock. The rest is cultivated and is used to grow small grain, mainly oats and wheat. Wildlife habitat is important in places. (Capability unit IVe-3; Sandy Divide range site)

Peyton sandy loam, wet, 1 to 5 percent slopes (PfC).--This gently sloping soil is in swales and on terraces along drainageways in the southeastern part of the Area. Most mapped areas are 20 to 100 acres in size and are long and irregularly shaped.

This soil has a profile similar to that described as representative for the series except that in places the substratum below a depth of 40 inches is cemented. In most years during parts of the spring or early summer a water table is present below a depth of 36 inches.

Included with this soil in mapping are small areas of Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes, that are on knobs or small rises about 1 acre in size and that make up about 30 percent of each mapped area. Also included are small areas of Loamy wet alluvial land, springs, and wet areas.

Runoff is slow. The erosion hazard is slight to moderate, and it is greatest where there is runoff from adjacent areas. These soils are occasionally flooded, and some gullies are present.

Most areas of this soil are used for pasture, and many areas that were cultivated have been reseeded to grass. A few areas are planted to hay for winter feed. Wildlife habitat is important in places. (Capability unit IVw-1; Sandy Divide range site)

Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes (PpE).--This complex is an intricate pattern of about 40 percent Peyton sandy loam, about 25 percent Pring gravelly sandy loam, and about 25 percent Crowfoot sandy loam. In most places the Peyton soils and the Crowfoot soils are on side slopes and on the less sloping ridgetops, and Pring soils are on hill crests and the lower end of slopes.

Each of the soils of the Peyton and Crowfoot series has a profile similar to that described as representative for its respective series.

The Pring soil has a profile similar to that described as representative for the series, but the surface layer is sandy loam.

Included with these soils in mapping are small areas of Jarre, Brussett, and Tomah soils and small areas of rock outcrop. Taken together, these areas make up about 10 percent of each mapped area. Also included is an area between Parker and Franktown that has a thin to moderate cover of pine.

Runoff is medium to rapid. The erosion hazard is moderate to high.

About two-thirds of the area of these soils has a native grass cover. The remaining third has a brush cover of mainly Gambel oak and some mountain-mahogany. The brush is most common on the Crowfoot soils. These soils are used for grazing livestock, wildlife habitat, and recreation. A few areas have been cultivated, but most have been reseeded to grass. Urban development has taken place in some areas. (All soils: capability unit VIe-3; Peyton and Crowfoot soils: Sandy Divide range site. Pring soil: Loamy Park range site)

Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded (PrE2).--This eroded complex is an intricate pattern of about 40 percent Peyton sandy loam, about 25 percent Pring gravelly sandy loam, and about 20 percent Crowfoot sandy loam. These gently sloping to moderately steep soils are on uplands in the southern part of the Area.

The Peyton soil has a profile similar to that described as representative for the series, but the surface layer is about 5 inches thick.

The Pring soil has a profile similar to that described as representative for the series, but the surface layer is about 6 inches thick.

The Crowfoot soil has a profile similar to that described as representative for the series, but the surface layer is about 7 inches thick.

Included with these soils in mapping are areas of Truckton sandy loam, 3 to 8 percent slopes, and Kippen loamy sand, 1 to 20 percent slopes. Also included are areas where the surface layer has been completely removed through erosion and areas where blown soil has accumulated to a depth of 20 to 30 inches. Taken together, these areas make up about 15 percent of each mapped area.

Runoff is rapid. The hazard of erosion and soil blowing is high. Water erosion is the major hazard. Gullies 1 to 3 feet deep at intervals of about 200 feet are common, and some large drainageways are gullied to a depth of about 6 feet.

Most of these soil areas are used for grazing. Some areas are suited to wildlife habitat. (Capability unit VIe-3; Sandy Divide range site)

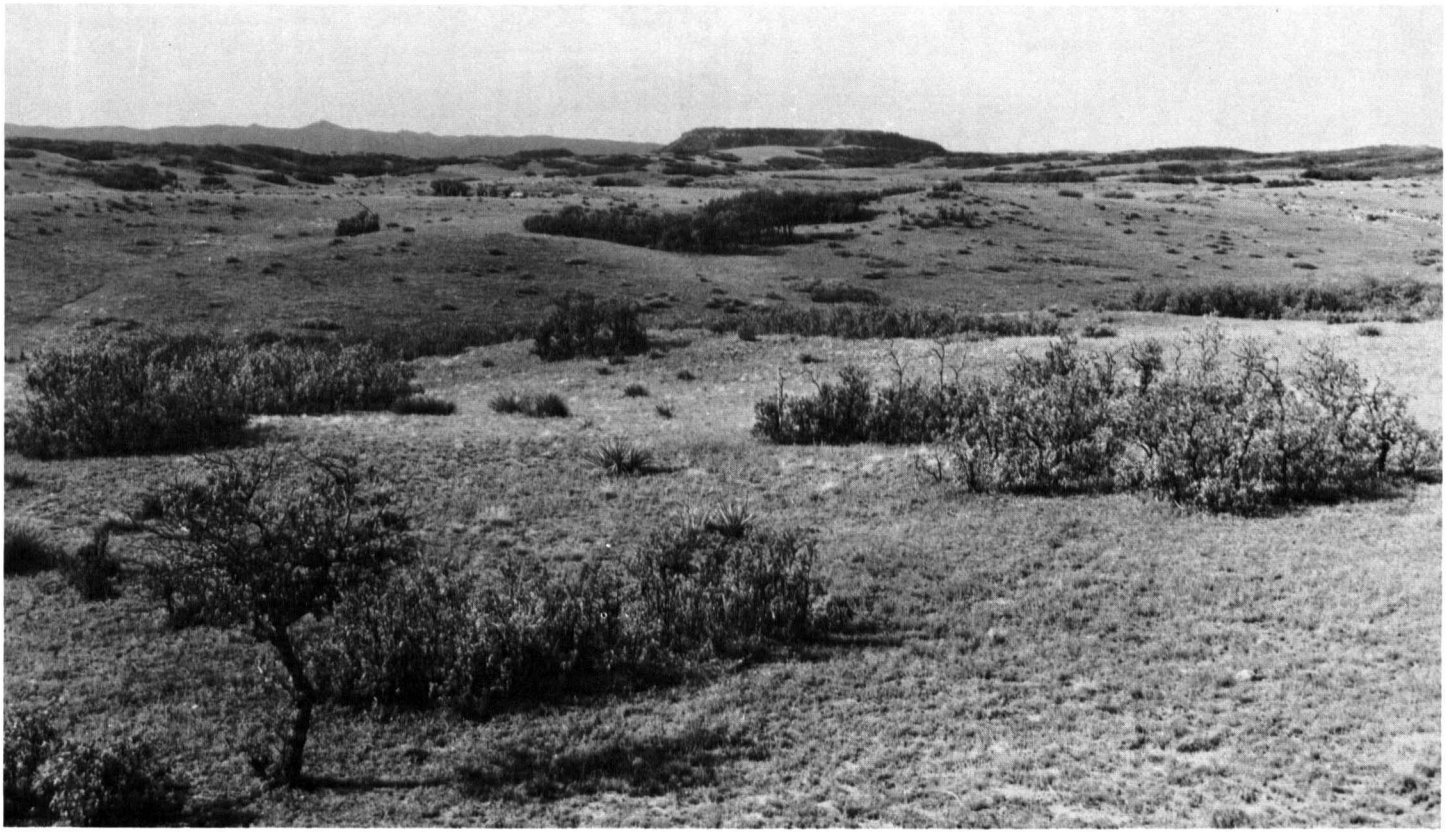
Plome Series

The Plome series consists of well-drained soils that formed in alluvium derived from weathered red and reddish-brown arkosic sedimentary rock. These sloping to steep soils are on upland hills and ridges. Slopes are 5 to 25 percent. The vegetation is mainly ponderosa pine and some Douglas-fir. Some Gambel oak, mountain muhly, and mid and tall grasses are present. Elevations are 6,500 to 7,500 feet. Annual precipitation is 17 to 19 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 125 days and less.

In a representative profile the surface layer is dark-gray sandy loam about 2 inches thick, and the subsurface layer, about 18 inches thick, is light reddish-brown and pink loamy sand and sandy loam. The subsoil, about 34 inches thick, is weak-red sandy clay loam and sandy loam extending to a depth of 54 inches or more.

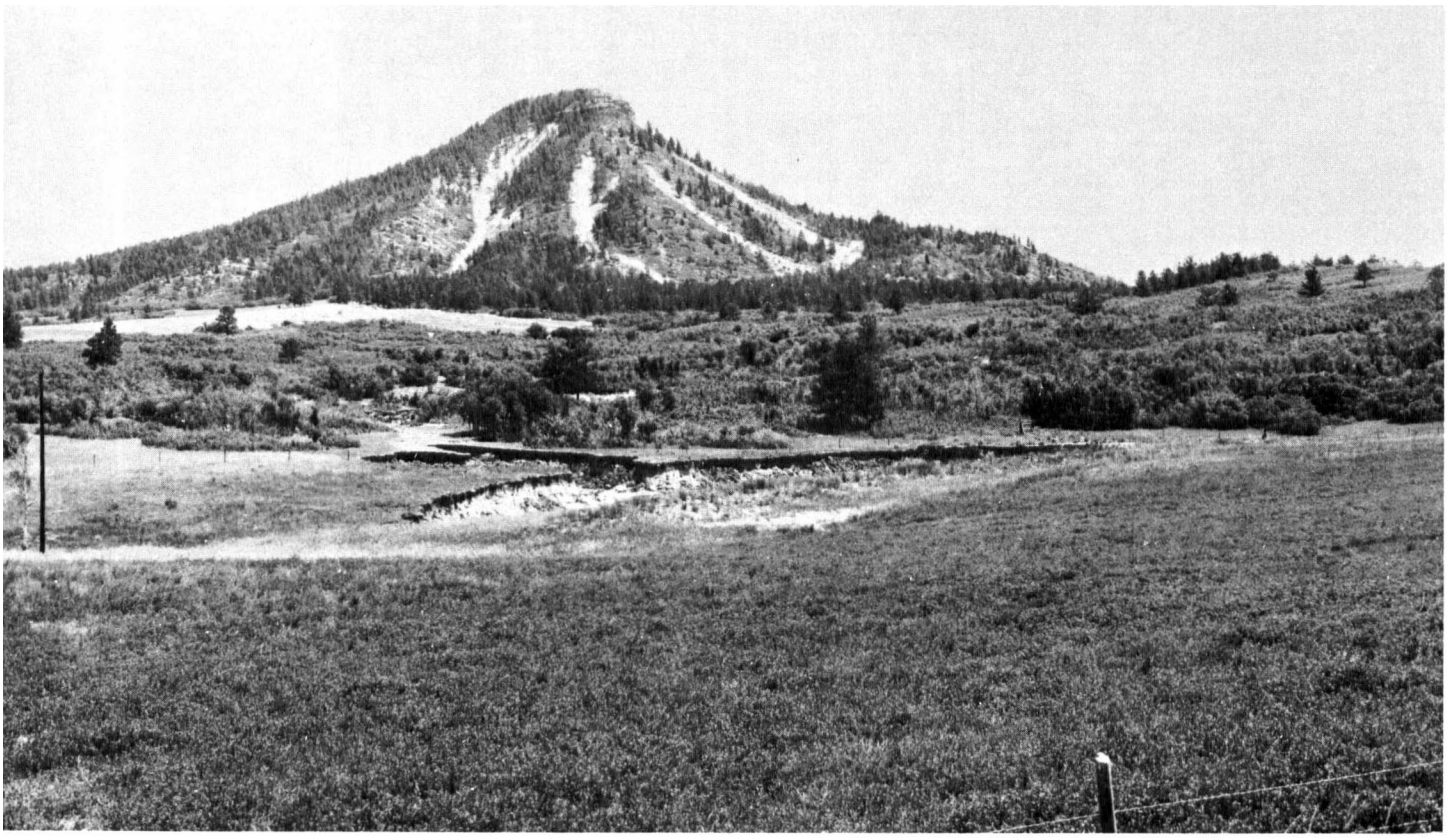
Plome soils have moderate permeability. Available water capacity is moderate. Plants can penetrate to a depth of 54 inches or more.

Gullies formed on Loamy alluvial land during a heavy rainstorm. Gullies are common in drainageways throughout the Castle Rock Area.



Fondis-Kutch soil association showing cover of native grass and Gambel oak.

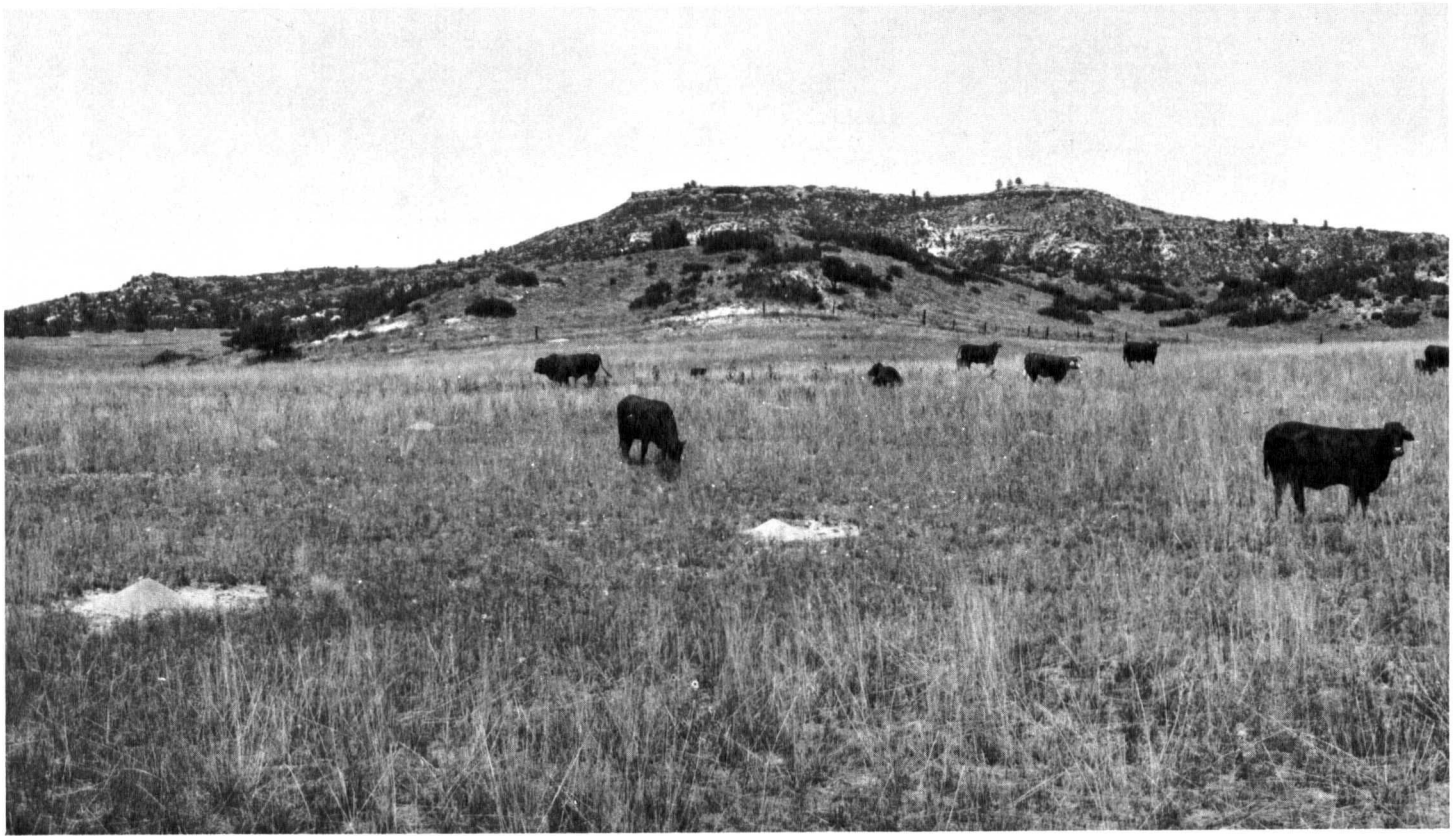
PLATE II



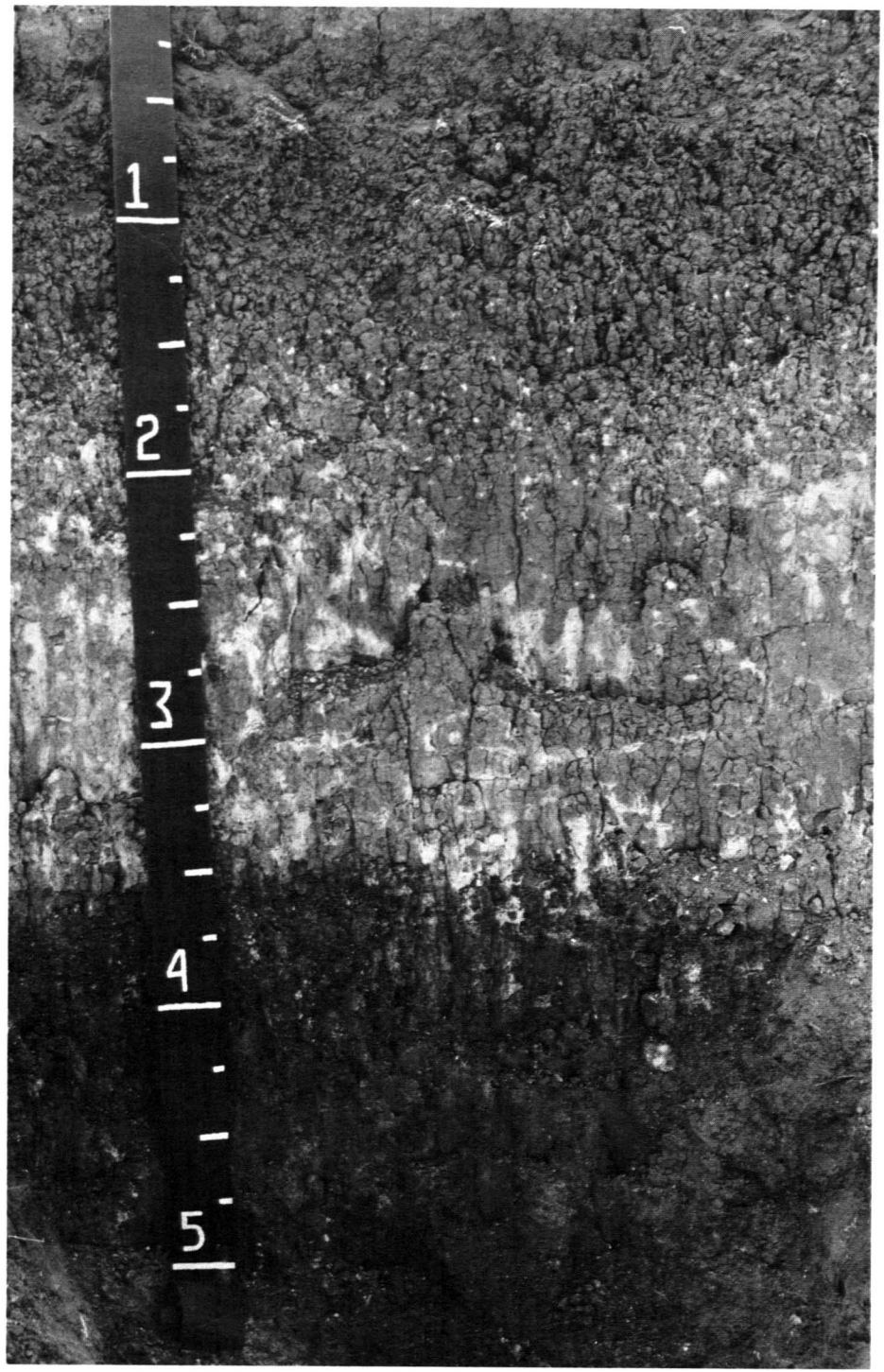
Water erosion on Peyton-Kettle-Crowfoot soil association. Light-colored area on Raspberry Butte is massive soil slippage after a heavy rainstorm.

Stock pond on Brussett-Jarre soil association in southern part of the Area. Coni rocky loam, 3 to 100 percent slopes, is in foreground.

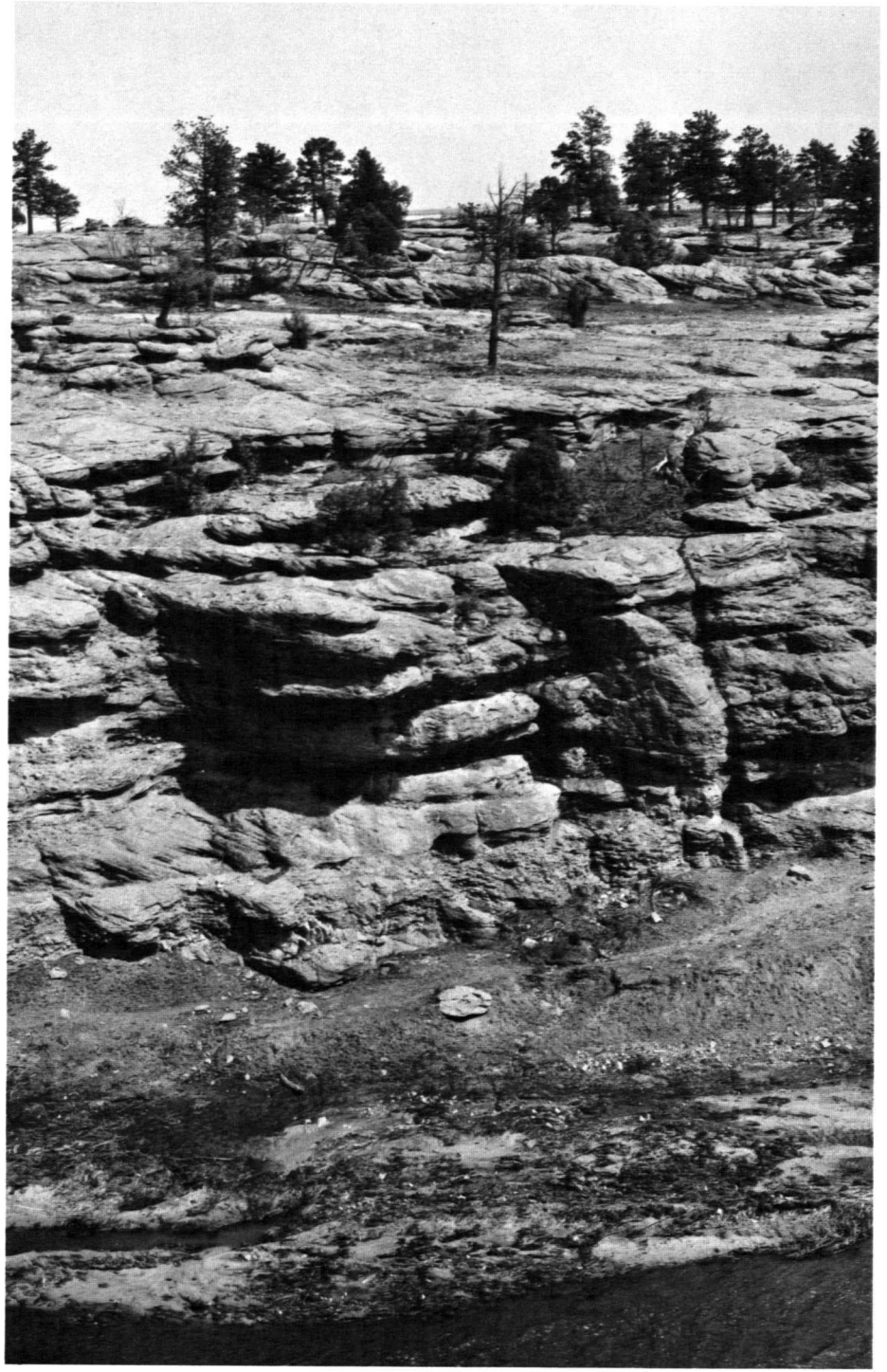
Long, narrow bands of Rockland in Garber-Kassler-Rockland soil association in Roxborough Park.



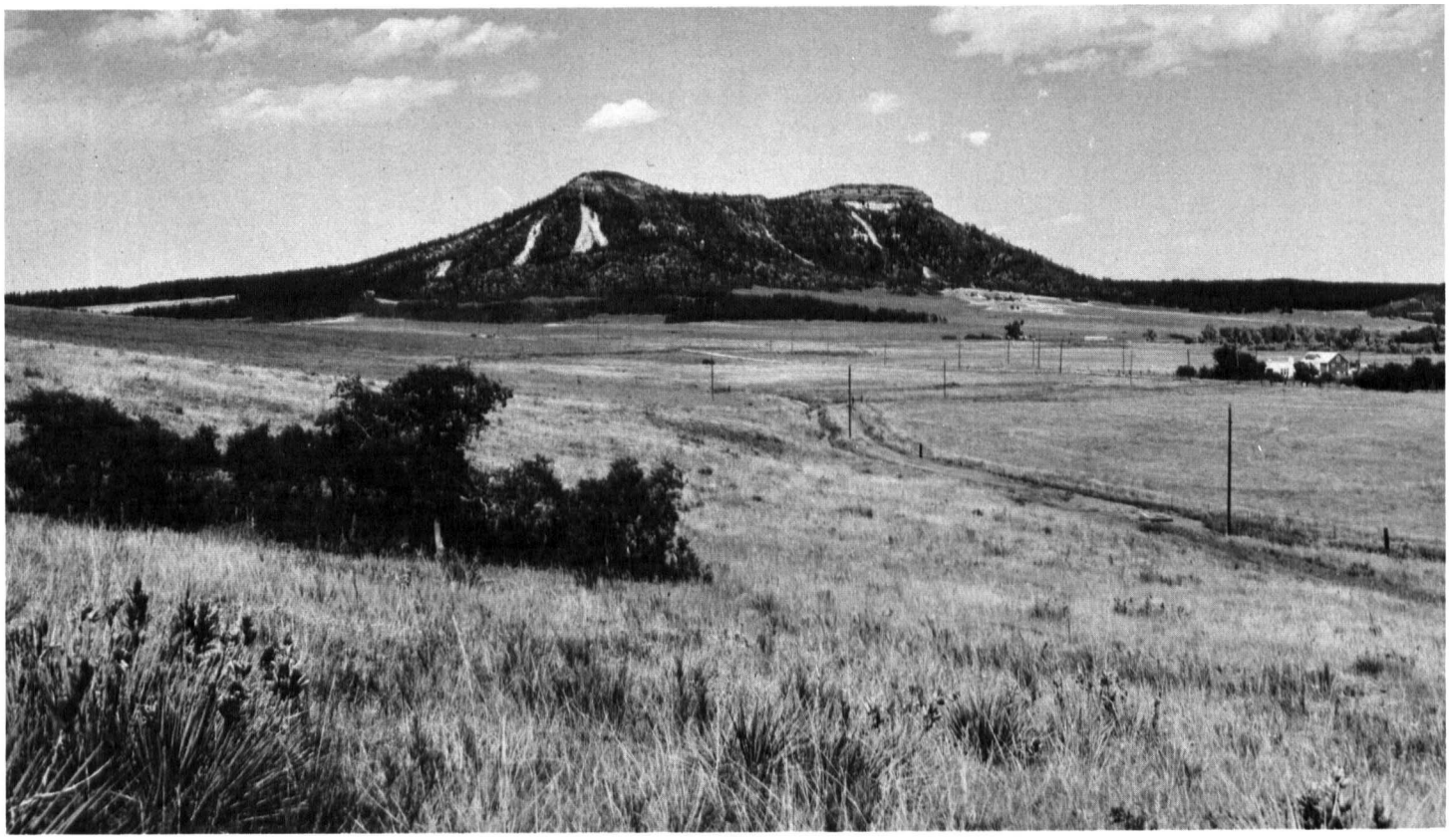
Pasture of intermediate wheatgrass and Russian wildrye on Bresser sandy loam, 3 to 9 percent slopes. Hillside in background is Stony steep land.



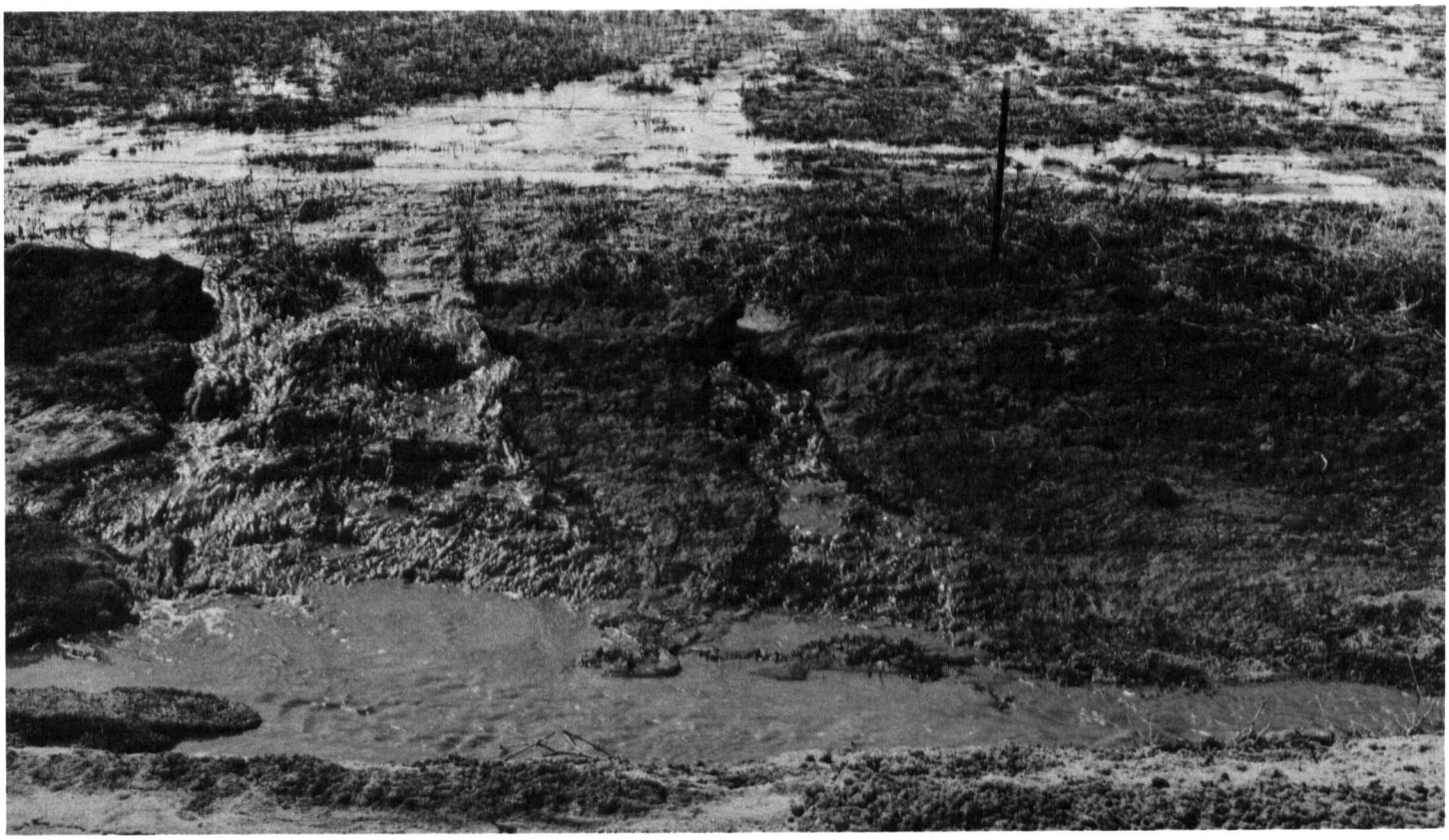
Profile of Buick loam in Buick-Satanta loams, 3 to 9 percent slopes.



Rock outcrop near the edge of tableland in an area of Coni rocky loam, 3 to 100 percent slopes.



Native grass on Garber gravelly sandy loam, 5 to 30 percent slopes. Raspberry Butte is in background.



Runoff from snowmelt on Peyton sandy loam, 3 to 9 percent slopes. Rills and gullies form easily during this time.

PLATE VI

Ponderosa pine on Plome loamy sand, 5 to 25 percent slopes, in the Perrypark area.

Cultivated area of Pring and Kippen gravelly sandy loam, 1 to 25 percent slopes, severely damaged by runoff from adjacent areas.

Rhyolite quarry south of Castle Rock mined for building and construction stone.

Stony steep land, cold, along East Plum Creek in southern part of Area. Slide in center caused by soil slippage after a heavy rainstorm.

All areas of Plome soils are in native vegetation and are used for grazing livestock, wildlife habitat, and recreation. The trees are used for poles and posts, and to limited degree for lumber.

Representative profile of a Plome loamy sand, 300 feet east and 100 feet south of the northwest corner of sec. 26, T. 9 S., R. 68 W.:

O1--2 inches to 0, organic materials, mainly needles, bark, twigs, and leaves.
A1--0 to 2 inches, dark-gray (5YR 4/1) light sandy loam, black (5YR 2/1) when moist; weak, fine, granular structure; soft, very friable; neutral (pH 6.6); clear, wavy boundary.
A21--2 to 7 inches, light reddish-brown (5YR 6/3) loamy sand, dark reddish brown (5YR 3/3) when moist; very weak, medium, subangular blocky structure; soft, very friable; slightly acid (pH 6.4); clear, smooth boundary.
A22--7 to 16 inches, pink (5YR 7/3) loamy sand, reddish brown (5YR 5/3) when moist; massive; slightly hard, very friable; slightly acid (pH 6.2); abrupt, smooth boundary.
A&B--16 to 20 inches, pink (5YR 7/3) loamy sand with nodules and seams of weak-red (10R 5/4) sandy clay loam; light reddish brown (2.5YR 6/4) when crushed, reddish brown (5YR 5/3) and weak red (10R 4/4) when moist; reddish brown (2.5YR 4/4) when crushed; moderate, medium, subangular blocky structure; hard, very friable; slightly acid (pH 6.2); abrupt, smooth boundary.
B2t--20 to 36 inches, weak-red (10R 5/4) sandy clay loam, weak red (10R 4/4) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, friable; thin nearly continuous clay films on both horizontal and vertical faces of peds; slightly acid (pH 6.2); gradual, smooth boundary.
B3--36 to 54 inches, weak-red (10R 5/4) sandy loam, weak red (10R 4/4) when moist; weak, coarse, prismatic structure; hard, very friable; thin patchy clay films on both horizontal and vertical faces of peds; slightly acid (pH 6.4).

The A1 horizon ranges from 1 to 4 inches in thickness, and the A2 horizon ranges from 5 to 20 inches in thickness. The A horizon ranges from sandy loam to sand in texture. The B2t horizon ranges from 12 to 40 inches in thickness, and from heavy sandy loam to sandy clay loam in texture. In places bedrock is at a depth of 40 inches or more.

Plome loamy sand, 5 to 25 percent slopes (PsE).--This sloping to steep soil is in wooded areas in the southwestern part of the Area. Most mapped areas are greater than 200 acres in size.

Included with this soil in mapping are small areas of Garber gravelly sandy loam, 5 to 30 percent slopes, and Redtom sandy loam. Also included are a few areas where red sandstone stands as sentinels.

Runoff is slow to medium. The erosion hazard is slight. Some gullies are present in drainageways in areas where stands of trees are thin or where logging has taken place.

Areas of this soil are used for woodland products, grazing of livestock, wildlife habitat, and recreation (plate VI, top). Trees are used for fence poles and posts, and to limited degree for lumber. In some areas homesites are present. (Capability unit VIe-5; not placed in a range site)

Pring Series

The Pring series consists of well-drained soils that formed in alluvium derived from weathered arkosic sedimentary rock. These gently sloping to steep soils are on valley side slopes. Slopes are 1 to 25 percent. The vegetation is mid and tall grasses. Elevations are 6,500 to 8,000 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 12 inches thick, is dark grayish-brown gravelly sandy loam. Below this is light brownish-gray and light-gray gravelly sandy loam extending to a depth of 60 inches or more.

Pring soils have moderately rapid permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Pring soils are in native grasses and used mainly for grazing livestock, but a few areas on the more gentle slopes are cultivated. Corn for silage is the main crop. Many cultivated areas have been reseeded to grass. Urban development has taken place in some areas.

Representative profile of a Pring gravelly sandy loam, on the east side of Interstate 25, 450 feet north and 450 feet east of the center of sec. 35, T. 10 S., R. 67 W.:

A11--0 to 6 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard, very friable; 15 percent fine gravel; neutral (pH 6.8); clear, smooth boundary.
A12--6 to 12 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure; hard, very friable; few, thin, patchy clay films on vertical faces of peds; 15 percent fine gravel; neutral (pH 6.8); gradual, smooth boundary.
AC--12 to 18 inches, light brownish-gray (2.5Y 6/2) gravelly sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, subangular blocky structure; extremely hard, very friable; 20 percent fine gravel; neutral (pH 6.8); gradual, wavy boundary.
C--18 to 60 inches, light-gray (2.5Y 7/2) gravelly sandy loam, light olive brown (2.5Y 5/3) when moist; massive; extremely hard, very friable; 20 percent fine gravel; neutral (pH 6.8).

The A horizon ranges from 4 to 20 inches in thickness and from gravelly sandy loam to sandy loam in texture. In places hard rock is below a depth of 40 inches.

Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes (PvE).--This undifferentiated soil group is made up of Pring gravelly sandy loam and Kippen gravelly sandy loam. In a typical area of these soils, both are present, but in places only one of them is. In most places Pring soils are on the upper part of side slopes and Kippen soils are on small knobs and on the lower part of side slopes.

The Pring soil has the profile described as representative for the series.

The Kippen soil has a profile similar to that described as representative for the series, but the surface layer is a gravelly sandy loam.

Included with these soils in mapping are small areas of Crowfoot-Tomah sandy loams, 5 to 25 percent slopes, and Peyton sandy loam, 3 to 9 percent slopes. Taken together, these soils make up about 10 percent of each mapped area.

Runoff is medium. The erosion hazard is slight to moderate (plate VI, bottom). Areas of this soil group are used for livestock grazing. (Pring soils: capability unit VIe-3; Loamy Park range site. Kippen soils: capability unit VIe-3; Sandy Divide range site)

Razor Series

The Razor series consists of moderately deep, well-drained soils that formed in clayey soil materials or alluvium derived from shale. These gently sloping to steep soils are on uplands in the western part of the Area. Slopes are 3 to 25 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer is grayish-brown clay about 3 inches thick. The subsoil, about 9 inches thick, is olive clay. The underlying material is olive clay. Calcareous shale is at a depth of about 34 inches.

Razor soils have slow permeability. Available water capacity is moderate. Plants can penetrate to a depth of 20 to 40 inches.

Most areas of Razor soils are in native grasses and are used for grazing beef cattle. They are not suited to cultivation.

Representative profile of a Razor clay, 600 feet north and 100 feet west of the southeast corner of the southwest quarter of sec. 10, T. 9 S., R. 68 W.:

A1--0 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; strong, very fine, granular structure; very hard, very firm; mildly alkaline (pH 7.6); clear, smooth boundary.

B2--3 to 12 inches, olive (5Y 5/3) clay, olive (5Y 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, very friable; few, thin, patchy clay films on vertical faces of peds; some slickensides; strongly calcareous; moderately alkaline (pH 8.2); gradual, smooth boundary.

Cca--12 to 34 inches, olive (5Y 5/3) clay, olive (5Y 4/3) when moist; weak, coarse, prismatic structure; very hard, very firm; slickensides common; very strongly calcareous with common, medium, distinct lime concretions; moderately alkaline (pH 8.4); gradual, smooth boundary.

R--34 to 60 inches, olive (5Y 5/3) when moist or dry, calcareous shale; contains gypsum seams 1/4 to 3 inches thick.

The A horizon ranges from 2 to 4 inches in thickness and from clay loam to clay or silty clay in texture. The B horizon ranges from 4 to 26 inches in thickness and grades from weak to moderate in structure. Calcareous shale is at depths between 20 and 40 inches.

Razor clay, 3 to 25 percent slopes (RaE).--This gently sloping to steep soil is on uplands mainly in the western part of the Area. Most mapped areas are greater than 60 acres in size and are irregularly shaped.

Included with this soil in mapping are small areas of Heldt clay and Englewood clay loam. Also included are areas of shale outcrop less than a half acre in size. Cobblestones and gravel are present on the small knobs.

Runoff is rapid. The erosion hazard is moderate, and soil slippage is common. Gullies form easily in drainageways.

Areas of this soil are used for livestock grazing. A few small areas have water-spreading ditches and are used for growing hay. (Capability unit VIe-1; Clayey Foothill range site)

Rednun Series

The Rednun series consists of well-drained soils that formed in calcareous alluvial fan sediments derived from redbed shale and limestone. These gently sloping to sloping soils are on valley side slopes. Slopes are 3 to 10 percent. The vegetation is short and mid grasses. Elevations are 6,200 to 6,800 feet. Annual precipitation is 16 to 18 inches. Mean annual soil temperature is 45° to 50° F., and the frost-free season is 120 to 125 days.

In a representative profile the surface layer is reddish-brown loam about 6 inches thick. The subsoil, about 36 inches thick, is dark reddish-brown, reddish-brown, and yellowish-red clay and clay loam. The underlying material is reddish-yellow loam that extends to a depth of 60 inches or more.

Rednun soils have slow permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Rednun soils are in native grasses and are used for grazing livestock. A few areas on the smoother slopes are or have been dryfarmed.

Representative profile of a Rednun loam, 1,500 feet west and 1,320 feet south of the northeast corner of sec. 14, T. 9 S., R. 68 W.:

Ap--0 to 6 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium to fine, granular structure; slightly hard, friable; neutral (pH 6.8); clear, smooth boundary.

B1--6 to 10 inches, reddish-brown (5YR 5/3) light clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard, friable; neutral (pH 6.8); clear, smooth boundary.

B21t--10 to 20 inches, dark reddish-brown (5YR 3/3) clay, dark reddish brown (5YR 3/4) when moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky; very hard, very firm; thin nearly continuous clay films on horizontal and vertical faces of peds; mildly alkaline (pH 7.4); clear, smooth boundary.

B22t--20 to 29 inches, reddish-brown (5YR 4/3) clay, reddish brown (5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; very hard, very firm; thin nearly continuous clay films on horizontal and vertical faces of peds; strongly calcareous; moderately alkaline (pH 8.0); gradual, smooth boundary.

B3ca--29 to 42 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable; few, thin, patchy clay films on vertical faces of peds; common, fine, distinct lime concretions; very strongly calcareous; moderate alkaline (pH 8.2); gradual, smooth boundary.

Cca--42 to 60 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 5/6) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; soft, very friable; very strongly calcareous; moderately alkaline (pH 8.2).

The A horizon ranges from 4 to 8 inches in thickness and from loam to clay loam in texture. The B2t horizon ranges from 16 to 40 inches in thickness and from clay to heavy clay loam in texture. Lime is between depths of 10 and 30 inches. The C horizon ranges from loam to clay loam in texture. Bedrock is at a depth of 40 inches or more.

Rednun loam, 3 to 10 percent slopes (RdD).--This gently sloping to sloping soil is on uplands in the western part of the Area. Most mapped areas are less than 60 acres in size.

Included with this soil in mapping are areas of Satanta loam, calcareous variant, 3 to 9 percent slopes.

Runoff is medium. The erosion hazard is slight to moderate.

Most areas of this soil are in native grass and used for grazing. A few areas are cultivated and used mainly for growing wheat. (Capability unit IVe-3; Loamy Foothill range site)

Rednun-Redridge complex, 8 to 40 percent slopes (ReE).--This complex is an intricate pattern of about 50 percent Rednun loam and about 30 percent Redridge gravelly sandy loam. In most places the Rednun soil is on the less sloping areas and in swales between ridgetops, and the Redridge soil is on higher areas and on ridges.

Included with these soils in mapping are small areas of Newlin gravelly sandy loam, 8 to 30 percent slopes, Satanta loam, and Buick loam. Also included are small knobs of gravel outcrop. Taken together, the included areas make up about 20 percent of each mapped area.

Runoff is rapid. The erosion hazard is moderate. In most places gullying has occurred in drainageways.

Most areas of these soils are in native grass and brush, mainly Gambel oak and mountain-mahogany. These areas are used for grazing livestock and wildlife habitat. (Rednun soils: capability unit VIe-1; Loamy Foothill range site. Redridge soils: capability unit VIe-1; Gravelly Foothill range site)

Redridge Series

The Redridge series consists of well-drained soils that formed in alluvium derived from weathered, red, arkosic sedimentary rock. These moderately steep to steep soils are on ridges and side slopes in the western part of the Area. Slopes are 10 to 40 percent. The vegetation is mainly mountain-mahogany, Gambel oak, and some grasses. Elevations are 6,300 to 7,000 feet. Annual precipitation is 16 to 18 inches. Mean annual soil temperature is 48° to 50° F., and the frost-free season is 120 to 125 days.

In a representative profile the surface layer, about 10 inches thick, is reddish-gray to reddish-brown gravelly sandy loam. The subsoil is reddish-brown gravelly sandy clay loam and gravelly sandy loam about 16 inches thick. The underlying material is red very gravelly loamy sand that extends to a depth of 60 inches or more.

Redridge soils have moderate permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Areas of Redridge soils have a brush and grass cover and are used for grazing livestock and wildlife habitat.

Representative profily of a Redridge gravelly sandy loam, 500 feet west and 700 feet north of the southeast corner of the northwest quarter of sec. 9, T. 9 S., R. 68 W.:

A1--0 to 7 inches, reddish-gray (5YR 5/2) gravelly sandy loam, dark reddish brown (5YR 3/2) when moist; moderate, very fine, granular structure; soft, very friable; 15 percent gravel; neutral (pH 6.6); clear, smooth boundary.

A3--7 to 10 inches, reddish-brown (5YR 5/3) gravelly sandy loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; 15 percent gravel; neutral (pH 6.6); clear, smooth boundary.

B2t--10 to 20 inches, reddish-brown (2.5YR 5/4) gravelly sandy clay loam, reddish brown (2.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, very friable; thin nearly continuous clay films on faces of peds; 20 percent gravel; neutral (pH 6.6); clear, smooth boundary.

B3t--20 to 26 inches, reddish-brown (2.5YR 5/4) gravelly heavy sandy loam, reddish brown (2.5YR 4/4) when moist; weak to moderate, medium, subangular blocky structure; extremely hard, very friable; few, thin, patchy clay films on horizontal and vertical faces of peds; 20 percent gravel; neutral (pH 6.6); clear, wavy boundary.

IIC--26 to 60 inches, red (2.5YR 5/6) very gravelly loamy sand or sand, red (2.5YR 4/6) when moist; single grain; loose when dry and moist; 70 percent gravel; neutral (pH 6.8).

The A horizon ranges from 5 to 14 inches in thickness. The B horizon ranges from 6 to 24 inches in thickness and from gravelly sandy clay loam to gravelly clay loam in texture. Gravel content of the B horizon is 10 to 35 percent. Depth to the IIC horizon is 20 to 30 inches. Gravel content of the C horizon is 50 to 80 percent. In places, shale is at a depth of 60 inches or more.

Redridge-Chaseville gravelly sandy loams, 10 to 70 percent slopes (RgF).--This complex is an intricate pattern of about 40 percent Redridge gravelly sandy loam and about 35 percent Chaseville very gravelly loam. In most places the Redridge soil has slopes of less than 20 percent and is on ridgetops and extends part of the way down the slope. The Chaseville soil has slopes of more than 20 percent and is on side slopes below the Redridge soil.

Included with these soils in mapping are small areas of Rednun soils and Newlin gravelly sandy loam, 8 to 30 percent slopes. Also included are areas of reddish-colored gravel, shale, and sandstone. Taken together, these areas make up 25 percent of each mapped area.

Runoff is medium to rapid. The erosion hazard is moderate to high. Soil slippage is common on the steeper slopes.

Most areas of these soils are used for grazing livestock and wildlife habitat. (Capability unit VIe-2; Gravelly Foothill range site)

Redtom Series

The Redtom series consists of somewhat excessively drained soils that formed in alluvium or weathered reddish-brown arkosic sedimentary rock. These sloping to steep soils are on hills and ridges. Slopes are 5 to 25 percent. The vegetation is mainly mid and tall grasses, Gambel oak, mountain-mahogany, and a few ponderosa pine. Elevations are 6,400 to 7,000 feet. Annual precipitation is 17 to 19 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer is dark-brown sandy loam about 11 inches thick. The subsurface layer, about 6 inches thick, is light reddish-brown loamy sand. The subsoil, about 23 inches thick, is light reddish-brown and red loamy sand containing thin, dark reddish-brown bands of sandy clay loam. The underlying material is red loamy sand that extends to a depth of 60 inches or more.

Redtom soils have rapid permeability. Available water capacity is moderate. Plants penetrate to a depth of 60 inches or more.

Most areas of Redtom soils have a brush and grass cover and are used for grazing livestock and wildlife habitat.

Representative profile of Redtom sandy loam, 600 feet south and 600 feet east of the northwest corner of the southeast quarter of sec. 25, T. 9 S., R. 68 W.:

A1--0 to 11 inches, dark-brown (7.5YR 4/2) sandy loam, very dark brown (7.5YR 2/2) when moist; moderate, very fine, granular structure; soft, very friable; 5 percent fine and very fine, angular granitic gravel; neutral (pH 6.7); clear, smooth boundary.

A2--11 to 17 inches, light reddish-brown (5YR 6/3) loamy sand, reddish brown (5YR 4/3) when moist; weak, thick, platy structure parting to weak, medium, subangular blocky; hard, very friable; 5 to 10 percent fine and very fine, angular, granitic gravel; neutral (pH 6.7); clear, smooth boundary.

A&B--17 to 22 inches, light reddish-brown (5YR 6/3) loamy sand containing nodules and discontinuous dark reddish-brown (2.5YR 3/4) dry and moist, 1/16 to 1/4 inch thick lamellae of sandy clay loam; horizon reddish brown (5YR 4/3) when moist; weak, medium, subangular blocky structure; hard, very friable; thin patchy clay films on aggregate faces in the lamellae; 5 percent fine and very fine, angular, granitic gravel; neutral (pH 6.7); gradual, wavy boundary.

B&A--22 to 40 inches, red (2.5YR 5/5) loamy sand containing dark reddish-brown (2.5YR 3/4, dry and moist) 1/2 to 1 inch thick lamellae of sandy clay loam; horizon dark reddish brown (2.5YR 4/4) when moist; single grained in matrix and moderate, medium, subangular blocky structure in lamellae; matrix loose when dry and moist, and lamellae very hard when dry and very friable when moist; thin nearly continuous clay films on aggregate faces in the lamellae; slightly acid (pH 6.4); diffuse, wavy boundary.

C--40 to 60 inches, red (2.5YR 5/5) loamy sand, red (2.5YR 4/5) when moist; single grain; loose when dry and moist; 5 to 10 percent, fine and very fine, angular, granitic gravel; slightly acid (pH 6.4).

The A1 horizon ranges from 10 to 20 inches in thickness and from sandy loam to loamy sand in texture. The A2 horizon ranges from 3 to 12 inches in thickness and from loamy sand to sand in texture. The B&A horizon ranges from 16 to 30 inches in thickness. The C horizon ranges from sand to sandy loam in texture.

Redtom-Lonetree complex, 5 to 25 percent slopes (RlE).--This complex is an intricate pattern of about 60 percent Redtom sandy loam and about 25 percent Lonetree loamy sand. The Redtom soil is on side slopes, and the Lonetree soil is at the base of the side slopes.

Included with these soils in mapping are small areas of Perrypark sandy loam, 3 to 20 percent slopes, Garber gravelly sandy loam, Cheeseman loam, Sandy alluvial land, and rock outcrop. Taken together, these areas make up about 15 percent of each mapped area.

Runoff is slow to medium. The erosion hazard is slight. In some areas a few gullies have formed in drainageways.

Most areas of these soils are used for grazing livestock and for wildlife habitat. (Capability unit VIe-4; Sandy Divide range site)

Renohill Series

The Renohill series consists of well-drained soils that formed in materials weathered from calcareous clay shale. These sloping to steep soils are on uplands. Slopes are 3 to 25 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,200 feet. Annual precipitation is 15 to 17 inches. Mean annual soil temperature is 48° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 3 inches thick, is light brownish-gray clay loam. The subsoil is grayish-brown and brown clay loam about 21 inches thick. Calcareous clay shale is at a depth of about 24 inches.

Renohill soils have slow permeability. Available water capacity is moderate. Plants can penetrate to a depth of 20 to 40 inches.

Most areas of Renohill soils are in native grasses and are used for grazing livestock.

Representative profile of a Renohill clay loam, 2,640 feet west and 30 feet south of the northeast corner of sec. 3, T. 6 S., R. 67 W.:

A1--0 to 3 inches, light brownish-gray (10YR 6/2) light clay loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; soft, very friable; neutral (pH 7.2); clear, smooth boundary.

B2t--3 to 12 inches, grayish-brown (10YR 5/2) heavy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium to fine, angular blocky structure; hard, friable; few, thin, patchy clay films on vertical faces of peds; mildly alkaline (pH 7.5); clear, smooth boundary.

B3--12 to 24 inches, brown (7.5YR 5/4) clay loam, brown or dark brown (7.5YR 4/4) when moist; weak, coarse, subangular blocky structure; hard, friable; calcareous with few, fine, distinct lime concretions; moderately alkaline (pH 8.4); gradual, smooth boundary.

R--24 inches, calcareous clay shale.

The A horizon ranges from 2 to 5 inches in thickness and from sandy clay loam to clay loam in texture. The B2t horizon ranges from 6 to 30 inches in thickness and from heavy clay loam to clay in texture. Depth to lime ranges from 6 to 20 inches.

Renohill-Buick complex, 5 to 25 percent slopes (RmE).--This complex is an intricate pattern of about 50 percent Renohill clay loam and about 30 percent Buick loam. These soils are sloping to steep. In a typical area the Renohill soils are at lower elevations than the Buick soils.

The Renohill soil has a profile similar to that described as representative for the series, but the subsoil is about 10 inches thick. Depth to lime ranges from 6 to 10 inches.

The Buick soil has a profile similar to that described as representative for the series.

Runoff is medium to rapid. The erosion hazard is moderate. In most places gullies are in abandoned cultivated areas and in grassland areas that are overgrazed. Soil slippage is common where slopes exceed 15 percent.

Included with these soils in mapping are small areas of Fondis clay loam, 3 to 9 percent slopes, Satanta loam, and Manzanola clay loam. In places raw shale crops out in areas one-fourth acre to 1 acre in size. Taken together, these inclusions make up about 20 percent of each mapped area.

Most areas of these soils are used for grazing livestock. (Renohill soils: capability unit VIe-1; Clayey Foothill range site. Buick soils: capability unit VIe-1; Loamy Foothill range site)

Renohill-Manzanola clay loams, 3 to 20 percent slopes (RnE).--This complex is an intricate intermingling of about 50 percent Renohill clay loam and about 35 percent Manzanola clay loam. These sloping to moderately steep soils are on uplands in the extreme northern part of the Area. The Renohill soil is on the lower part of slopes and in most places extends into drainageways. The Manzanola soil is on the upper parts of slopes and on ridgetops.

Included with these soils in mapping are small areas of Fondis clay loam, 3 to 9 percent slopes, Buick loam, Newlin gravelly sandy loam, 8 to 30 percent slopes, and soils having shale above a depth of about 20 inches. Taken together, these make up about 15 percent of each mapped area.

Runoff is rapid. In most places the erosion hazard is moderate, but in cultivated areas the erosion hazard is high. Gullies have formed in drainageways where these soil are cultivated. Rills are common after moderate amounts of rainfall. Shale is exposed in some areas that are severely eroded.

Most areas of these soils are in native grass and are used for grazing livestock. A few areas are cultivated. (Capability unit VIe-1; Clayey Foothill range site)

Renohill Series, Reddish Variant

The Renohill series, reddish variant, consists of well-drained soils that formed in material weathered from noncalcareous red shale. These sloping to moderately steep soils are on uplands. Slopes are 5 to 20 percent. The vegetation is mid and tall grasses. Elevations are 5,700 to 6,200 feet. Annual precipitation is 15 to 17 inches. Mean annual soil temperature is 49° to 51° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer is dark-brown sandy loam about 8 inches thick. The subsoil is reddish-brown and weak-red clay about 24 inches thick. Weak-red, soft sandstone and shale are at a depth of about 32 inches.

These soils have slow permeability and moderate available water capacity. Plants can penetrate to a depth of 20 to 40 inches.

Most areas of these soils are in native grasses and are used for grazing livestock. These soils are a source of clay material used in manufacturing brick and tile, and clay pits are common.

Representative profile of a Renohill sandy loam, reddish variant, 500 feet south and 100 feet west of the northeast corner of sec. 27, T. 6 S., R. 66 W.:

A1--0 to 8 inches, dark-brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable; neutral (pH 6.8); clear, smooth boundary.

B21t--8 to 18 inches, reddish-brown (5YR 4/4) clay, reddish brown (5YR 4/4) when moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky; very hard, firm; nearly continuous clay films on horizontal and vertical faces of peds; neutral (pH 6.8); clear, smooth boundary.

B22t--18 to 32 inches, weak-red (10R 4/3) clay, weak red (10R 4/3) when moist; weak, medium, prismatic structure parting to moderate and strong, medium, angular blocky; hard, firm; thin patchy clay films on vertical faces of peds; neutral (pH 7.0); gradual, smooth boundary.

R--32 to 46 inches, weak-red (10R 4/3), weathered, noncalcareous shale.

The A horizon ranges from 5 to 10 inches in thickness and from loam to sandy loam in texture. The B horizon ranges from 5 to 30 inches in thickness and from heavy clay loam to clay or silty clay in texture. Weathered shale and sandstone are at a depth of 20 to 40 inches.

Renohill sandy loam, reddish variant, 5 to 20 percent slopes (RoE).--This sloping to moderately steep soil is on uplands in the northern part of the Area. Most mapped areas are less than 40 acres. They are long, narrow bands at an elevation of about 6,000 feet.

Included with this soil in mapping are areas of Newlin gravelly sandy loam, 8 to 30 percent slopes, and Satanta loam.

Runoff is medium to rapid. The erosion hazard is moderate.

Most areas of this soil are in native grass and are used for grazing livestock. This is a source area of clay for the manufacturing of brick and tile in the Denver area. (Capability unit VIe-1; Sandy Foothill range site)

Rock Land

Rock land-Lonetree complex, 10 to 100 percent slopes (RtG), is an intricate intermingling of about 40 percent Rock land and about 25 percent Lonetree loamy sand. This moderately steep to very steep complex is on hogback areas in the western part of the Area along the front range. Rock land consists of a very shallow soil and rock outcrops of red sandstone that in many areas stand as monuments and sentinels.

The Lonetree soil has a profile similar to that described as representative for the series, but it is a gravelly sandy loam. Red sandstone or shale is between depths of 40 and 60 inches. The north-facing slopes have a darker colored surface layer than the south-facing slopes.

Included with these areas in mapping are small areas of Garber gravelly sandy loam, 5 to 30 percent slopes, Tinytown soils, and a few small areas of pink and red limestone. Taken together, these areas make up 35 percent of each mapped area.

Runoff is rapid. The erosion hazard is moderate, and soil slippage is common.

Most areas of this complex are covered with brush. In most places mountain-mahogany is on south-facing slopes and Gambel oak is on north-facing slopes. Some mid and tall grasses are present. Grazing is limited. This complex is well suited to wildlife habitat and recreation. (Both parts of complex: capability unit VIIe-1. Lonetree soils: Shallow Foothill range site; Rock land not placed in a range site)

Sampson Series

The Sampson series consists of well-drained soils that formed in alluvium derived from weathered, arkosic, sedimentary rock. These gently sloping soils are on stream terraces and alluvial

fans. Slopes are 1 to 4 percent. The vegetation is mostly short grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 48° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 5 inches thick, is dark grayish-brown loam. The subsoil is dark grayish-brown and grayish-brown clay loam about 23 inches thick. The underlying material is light brownish-gray loam and silt loam that extends to a depth of 60 inches.

Sampson soils have moderately slow permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Most areas of Sampson soils are used to grow both irrigated and dryfarmed crops.

Representative profile of a Sampson loam, 500 feet west and 500 feet south of the northeast corner of sec. 3, T. 7 S., R. 66 W.:

A1--0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; soft, very friable; neutral (pH 6.6); clear, smooth boundary.

B1--5 to 9 inches, dark grayish-brown (10YR 4/2) heavy loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; slightly hard, friable; neutral (pH 6.8); clear, smooth boundary.

B21t--9 to 21 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, prismatic structure parting to strong, fine, subangular blocky; hard, friable; clay films on horizontal and vertical faces of peds; neutral (pH 7.2); gradual, smooth boundary.

B22t--21 to 28 inches, grayish-brown (2.5Y) clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, prismatic structure parting to strong, fine, subangular blocky; hard, friable; clay films on horizontal and vertical faces of peds; neutral (pH 7.2); abrupt, wavy boundary.

C1--28 to 38 inches, light brownish-gray (2.5Y 5/2) loam, grayish brown (2.5Y 4/2) when moist; moderate, medium, subangular blocky structure; slightly hard, very friable; strongly calcareous with few, medium, hard lime concretions; mildly alkaline (pH 7.6); clear, wavy boundary.

C2--38 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard, very friable; strongly calcareous; mildly alkaline (pH 7.6).

The A horizon ranges from 4 to 9 inches in thickness and from sandy loam to light clay loam in texture. The B horizon ranges from 11 to 36 inches in thickness. The C horizon ranges from sandy loam to clay loam in texture and in most places is stratified. There are thin lenses of loamy sand. In places lime is not present.

Sampson loam (1 to 4 percent slopes) (Sa).--This gently sloping soil is on terraces along major drainageways in the northern part of the Area. Most mapped areas are long and irregularly shaped and in most places less than 100 acres in size.

Included with this soil in mapping are small areas of Englewood clay loam and Bresser sandy loam, 1 to 3 percent slopes. Also included are a few small areas of Loamy alluvial land.

Runoff is slow. The erosion hazard is slight. In most places a water table is present below a depth of 60 inches.

Most areas of this soil are cultivated and are used to grow irrigated crops and pasture. Alfalfa, grass pasture, and corn for silage are the main irrigated crops. A few areas are dryfarmed. Wheat is the main dryland crop. (Capability unit IIIc-1, dryland; IIe-1, irrigated; Loamy Foothill range site)

Sandy Alluvial Land

Sandy alluvial land (Sd) is in broad swales and on small drainageways of the sandy uplands, mainly in the northern part of the Area. Slopes are 1 to 5 percent. These areas are long and narrow.

This land type has a light-colored surface layer of sand or loamy sand that is between 10 to 30 inches thick. The underlying material to a depth of more than 5 feet is stratified light-colored and dark-colored sand and sandy loam.

Included in mapping are areas of Loamy alluvial land, Loamy alluvial land, dark surface, and Bresser-Truckton sandy loams, 5 to 25 percent slopes. Wet areas are present, but most of them do not exceed 2 acres in size.

This land is subject to flooding during large storms, usually once every 5 years or less. Sand is deposited on the surface. The erosion hazard is moderate to high. Gullies are on the steeper slopes. Available water capacity is low, and permeability is rapid. The seasonal high water table is below a depth of 5 feet.

This land is not suitable for cultivation. Large dikes, dams, or similar protection would be necessary before this land could be cultivated. Because of the flooding, vegetation is variable. (Capability unit VIIw-1)

Sandy Wet Alluvial Land

Sandy wet alluvial land (Se) is on bottom lands along major drainageways in the northern part of the Area. Slopes are 1 to 5 percent. The areas are long and narrow.

This land type consists of light-colored stratified sand, loamy sand, and gravel.

Included with this land in mapping are small areas of Loamy wet alluvial land and Sandy alluvial land. Also included are a few stream channels. There are also small spring and water holes.

This land is poorly drained. Permeability is rapid, and available water capacity is low. Runoff is slow. The erosion hazard is moderate to high. The water table is at depths of 3 to 5 feet, and the soil is usually moist below a depth of 12 inches. This land is flooded during heavy rainstorms and during snowmelt in the spring. Gully erosion and deposition is common because of flooding.

This land is used mainly for grazing livestock. The vegetation consists of willows, annual grasses, sedges, and weeds. (Capability unit VIIw-1)

Satanta Series

The Satanta series consists of well-drained soils that formed in eolian material derived from mixed sources. These gently sloping to sloping soils are on uplands. Slopes are 1 to 8 percent. The vegetation is short and mid grasses. Elevations are 5,400 to 6,200 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 48° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profily the surface layer, about 9 inches thick, is grayish-brown loam. The subsoil is brown, yellowish-brown, and very pale brown clay loam or loam about 30 inches thick. The underlying material is light yellowish-brown loam that extends to a depth of 60 inches or more.

Satanta soils have moderate permeability. Available water capacity is high. Plants can penetrate to a depth of 60 inches or more.

Some areas of Satanta soils are in native grass and are used for grazing livestock. Some areas are dryfarmed, and a few areas are irrigated.

Representative profile of a Satanta loam, 400 feet east and 100 feet south of the northwest corner of sec. 30, T. 7 S., R. 67 W.:

A11--0 to 5 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft, very friable; slightly acid (pH 6.2); clear, smooth boundary.

A12--5 to 9 inches, grayish-brown (10YR 5/2) heavy loam, very dark brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, friable; neutral (pH 6.6); clear, smooth boundary.

B21t--9 to 23 inches, brown (10YR 5/3) clay loam, brown (10YR 4/3) when moist; strong, medium, prismatic structure parting to strong, medium, angular and subangular blocky; hard, firm; thin, nearly continuous clay films on faces of peds; neutral (pH 6.8); gradual, smooth boundary.

B22t--23 to 30 inches, light yellowish-brown (10YR 6/4) clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; neutral (pH 7.0); clear, wavy boundary.

B3ca--30 to 39 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; slightly hard, very friable; strongly calcareous with few, fine, distinct lime concretions; moderately alkaline (pH 8.0); diffuse, smooth boundary.

Cca--39 to 60 inches, light yellowish-brown (10YR 6/4) loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; strongly calcareous; moderately alkaline (pH 8.2).

The A horizon ranges from 4 to 12 inches in thickness and from loam to clay loam in texture. The B horizon ranges from 20 to 40 inches in thickness. In most places, the soil is noncalcareous to a depth of 20 to 36 inches, but in some places it is calcareous at a depth of 8 inches. The C horizon ranges from sandy loam to clay loam in texture.

Satanta loam (1 to 4 percent slopes) (Sn).--This gently sloping soil is on terraces and upland ridgetops in the northern part of the Area. Most mapped areas are long and narrow and are 20 to 80 acres in size.

Included with this soil in mapping are small areas of Sampson loam and of Fondis clay loam, 1 to 3 percent slopes. Also included are a few small areas of Buick loam and areas of Englewood clay loam along terraces.

Runoff is slow. The erosion hazard is slight. Some lower lying areas receive runoff from adjacent areas.

Most areas of this soil are cultivated and are used to grow dryland and irrigated crops. A few areas are in native grass. (Capability unit IIIc-1, dryland; IIe-1, irrigated; Loamy Foothill range site)

Satanta Series, Calcareous Variant

The Satanta series, calcareous variant, consists of well-drained soils that formed in calcareous alluvium and in residuum derived from limestone and shale. These sloping to moderately steep soils are on uplands. Slopes are 3 to 25 percent. The vegetation is short and mid grasses. Elevations are 5,500 to 6,700 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 50° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 10 inches thick, is grayish-brown and brown loam. The underlying material is light yellowish-brown clay loam that extends to a depth of 50 inches. It is underlain by shale.

These soils have moderate permeability. Available water capacity is high. Plant roots penetrate to a depth of 60 inches or more.

Most areas of these soils are in pasture and are used for grazing livestock. Most cultivated fields have been reseeded to permanent pasture.

Representative profile of a Satanta loam, calcareous variant, 1,200 feet south and 1,000 feet west of the northeast corner of sec. 14, T. 9 S., R. 68 W.:

Ap--0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when

moist; moderate, fine, granular structure; soft, friable; 5 percent fine limestone chips; slightly calcareous; moderately alkaline (pH 8.0); clear, smooth boundary.

A1--7 to 10 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable; 5 percent fine limestone chips; strongly calcareous; moderately alkaline (pH 8.2); clear, smooth boundary.

C1--10 to 24 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish-brown (10YR 5/4) when moist; weak, medium, subangular blocky structure; slightly hard, firm; very strongly calcareous with few, medium, distinct lime concretions and 5 percent limestone chips; moderately alkaline (pH 8.2); clear, smooth boundary.

C2ca--24 to 50 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) when moist; weak, medium, subangular blocky structure; very hard, very firm; very strongly calcareous with 5 to 10 percent fine limestone chips; moderately alkaline (pH 8.4); clear, smooth boundary.

R--50 to 60 inches, pale-olive (5Y 6/3) shale, olive (5Y 5/3) when moist.

The A horizon ranges from 5 to 14 inches in thickness and from loam to clay loam in texture. The C horizon ranges from 15 to 50 inches in thickness and from loam to clay loam in texture. The C horizon contains up to 30 percent gravel. Depth to shale or limestone is 40 to 60 inches or more.

Satanta loam, calcareous variant, 3 to 9 percent slopes (SrD).--This sloping soil is on uplands in the western part of the Area. Most mapped areas are more than 40 acres in size.

Included with this soil in mapping are small areas of Razor clay, 3 to 25 percent slopes, and Satanta loam. Also included is Loamy alluvial land in drainageways.

Runoff is medium. The erosion hazard is moderate.

Most areas of this soil are in native grass or reseeded permanent grass and are used for grazing livestock. On the west side of West Plum Creek a few small areas are irrigated and are used mainly for growing alfalfa. This soil could be used for production of dryland small grains. (Capability unit IVe-3, dryland; IVe-1, irrigated; Loamy Foothill range site)

Satanta loam, calcareous variant, 9 to 25 percent slopes (SrE).--This moderately steep soil is in long, narrow areas.

This soil has a profile similar to that described as representative of the Satanta series, calcareous variant, except that the content of lime fragments in the underlying material is 20 to 30 percent and the underlying bedrock is limestone.

Included with this soil in mapping are small areas of Satanta loam, calcareous variant, 3 to 9 percent slopes, and Tarryall gravelly loam, 10 to 50 percent slopes.

Runoff is rapid. The erosion hazard is high. This soil usually receives water runoff from higher lying areas.

Most areas of this soil are in native grass or are reseeded to grass, and they are used for grazing. (Capability unit VIe-3; Loamy Foothill range site)

Stapleton Series

The Stapleton series consists of well-drained soils that formed in alluvium derived from weathered arkosic sedimentary rock. These sloping to steep soils are on uplands. Slopes are 6 to 30 percent. The vegetation is mainly mid and tall grasses, but in places there is some ponderosa pine. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 49° to 51° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 7 inches thick, is grayish-brown sandy loam. The subsoil is pale-brown sandy loam about 9 inches thick. The underlying material is light brownish-gray coarse sandy loam that extends to a depth of 60 inches or more.

Stapleton soils have moderately rapid permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Stapleton soils are in native grasses and are used for grazing livestock, for wildlife habitat, and for recreation. In some places there are moderate to heavy stands of ponderosa pine.

Representative profile of a Stapleton sandy loam, 1,900 feet north and 500 feet east of the southwest corner of sec. 26, T. 6 S., R. 66 W.:

A1--0 to 7 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, very friable; 5 percent fine gravel; neutral (pH 6.8); clear, wavy boundary.

B2--7 to 16 inches, pale-brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; very hard, very friable; 10 percent fine gravel; neutral (pH 6.8); gradual, smooth boundary.

C1--16 to 26 inches, light brownish-gray (10YR 6/2) coarse sandy loam, grayish brown (10YR 5/2) when moist; massive; very hard, friable; 15 percent fine gravel; neutral (pH 6.8); clear, smooth boundary.

C2--26 to 60 inches, light brownish-gray (10YR 6/2) coarse sandy loam, grayish brown (10YR 5/2) when moist; massive; extremely hard, friable; 30 percent fine gravel; neutral (pH 6.8).

The A horizon ranges from 4 to 10 inches in thickness and from loamy sand to gravelly sandy loam and sandy loam in texture. A layer of pine needles, twigs, and bark 1/2 to 3 inches thick is present where there are pine trees. The B horizon ranges from 4 to 12 inches in thickness and from sandy loam to gravelly sandy loam in texture. The structure of the B horizon is weak to moderate.

Stapleton loamy sand, 6 to 30 percent slopes (SsE).--This sloping to steep soil is on uplands mainly in the vicinity of Franktown. Most mapped areas are larger than 80 acres in size.

This soil has a profile similar to that described as representative for the series except that it has a 2 inch thick layer of organic matter consisting of pine needles, twigs, and bark. The texture of the surface layer is loamy sand.

Included with some mapped areas of this soil is a similar soil that has a light-colored surface layer. This soil is on small knobs and ridges and makes up about 20 percent of the acreage of this soil. Also included are Kettle loamy sand, which is only on north-facing slopes; a few small areas of Bresser sandy loam, 3 to 9 percent slopes; Hilly gravelly land; and Kutch soil materials.

Runoff is medium. The erosion hazard is moderate. Some gullies are present in drainageways.

Areas of this soil have a cover of ponderosa pine trees and an understory of Gambel oak, mountain-mahogany, and grass. These areas are used for woodland products, grazing, wildlife habitat, and recreation. (Capability unit VIe-5)

Stapleton-Bresser association (8 to 30 percent slopes) (St).--This association is about 60 percent Stapleton sandy loam and about 25 percent Bresser sandy loam. These sloping to steep soils are on uplands in the vicinity of Franktown and Parker. The Stapleton soil is on ridges, knobs, and side slopes. The Bresser soil is on the lower end of slopes close to drainageways.

The Stapleton soil has the profile described as representative for the series.

The Bresser soil has the profile similar to the one described as representative for the series, but in many places shale or sandstone is at a depth of about 40 inches.

Included with these soils in mapping are small areas of a soil similar to the Stapleton soil, but it has a light-colored surface layer. Also included are long, narrow areas of Loamy alluvial land in drainageways. Taken together, these make up about 15 percent of each mapped area.

Runoff is medium to rapid. The erosion hazard is moderate to high.

Most areas of these soils are in native grass. Gambel oak, mountain-mahogany, and ponderosa pine are the common vegetation. These areas are used for grazing livestock, wildlife habitat, and recreation. Urban development has taken place in some areas. (Capability unit VIe-2; Sandy Foothill range site)

Stony Rough Land

Stony rough land (Su) is on hills or knobs and mesa side slopes in the southern part of the Area. Slopes are 5 to 40 percent. These areas are in narrow bands, but most of them exceed 200 acres in size.

About 30 to 90 percent of this land type is covered with rhyolite stone. The surface layer, about 6 inches thick, is a dark-colored flaggy loam. The underlying material, about 24 inches thick, is a flaggy to gravelly clay loam or sandy clay loam. Rhyolite is between depths of 20 and 40 inches.

Included with this land in mapping are areas of Fondis clay loam, 3 to 9 percent slopes, that are on the highest part of the landscape and on mesa tops. Also included on the lower part of slopes are areas of Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes. Rhyolite crops out in areas less than 2 acres in size.

Permeability is moderate, and available water capacity is low. Runoff is rapid. The erosion hazard is slight to moderate. Soil slippage takes place on the steeper slopes.

All of the acreage is in native vegetation consisting of grass, mountain-mahogany, and Gambel oak. It is used for grazing livestock and wildlife habitat. This land is a good source of rhyolite for building stone (plate VII, top). Some areas are mined. (Capability unit VIIs-1; Stony Loam range site)

Stony Steep Land

Stony steep land (Sv) is in the warmer, northern part of the Area. Slopes are 9 to 65 percent. The areas are in long stringers on hillsides, and most of them exceed 80 acres in size.

This land type ranges from cobbly and gravelly sandy loam to clay loam in texture. Shale is between depths of 10 and 30 inches. The shale fragments are mainly a mixture of rhyolite and conglomerate. Cliffs are common, and stones up to 20 feet in diameter are on the lower slopes. Rock outcrop is in about 30 percent of the area.

This land is well drained. Permeability is moderate, and available water capacity is low. Runoff is rapid. The erosion hazard is moderate. Some soil slippage takes place. The major land uses are limited to grazing and wildlife.

This acreage is dominated by Gambel oak and mountain-mahogany. Ponderosa pine, juniper, and grass are also present. (Capability unit VIIs-1; Rocky Foothill range site)

Stony Steep Land, Cold

Stony steep land, cold (Sw) is in the cooler, southern part of the Area (plate VII, bottom). Slopes are 9 to 65 percent. The areas are long

stringers on hillsides along the edges of tablelands. Most of them exceed 100 acres in size. Cliffs 10 to 100 feet high are common, and many boulders up to 20 feet in diameter are scattered on the slopes below cliffs. Deep canyons and drainageways at the base of slopes are common.

This land type has a dark-colored surface layer of cobbly and stony sandy loam. The underlying material is cobbly and gravelly sandy loam to clay loam. Shale or sandstone is between depths of 20 and 40 inches.

Included with this land in mapping are small areas of Kettle-Falcon soils, Stony rough land, and Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes.

Surface runoff is rapid, and the erosion hazard is moderate. Soil slippage is common.

All of the acreage is in native grass and brush. A few ponderosa pine and Rocky Mountain juniper are present. Mountain-mahogany and Gambel oak are the dominant vegetation. The main uses are grazing of livestock and wildlife habitat. (Capability unit VIIs-1; Stony Loam range site)

Tarryall Series

The Tarryall series consists of well-drained soils that formed in materials weathered from limestone or in colluvium. These moderately steep to very steep soils are on hills and ridges. Slopes are 10 to 50 percent. The vegetation is mid and tall grasses. Elevations are 5,500 to 6,800 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 47° to 52° F., and the frost-free season is 120 to 135 days.

In a representative profile the surface layer, about 10 inches thick, is dark grayish-brown gravelly loam. The underlying material is light brownish-gray gravelly loam about 20 inches thick. Limestone is at a depth of about 30 inches.

Tarryall soils have moderate permeability. Available water capacity is low. Plants can penetrate to a depth of 20 to 40 inches.

Areas of Tarryall soils are in native grasses, brush, and a few ponderosa pine. They are used for grazing livestock and wildlife habitat.

Representative profile of a Tarryall gravelly loam, 650 feet west and 700 feet north of the southeast corner of sec. 14, T. 9 S., R. 68 W.:

A1--0 to 10 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) when moist; very weak, medium, subangular blocky structure parting to moderate, very fine, granular; soft, very friable; 20 percent limestone gravel; calcareous; moderately alkaline (pH 8.2); clear, smooth boundary.

AC--10 to 18 inches, light brownish-gray (2.5Y 6/2) gravelly loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure; hard, very friable; 25 percent limestone gravel; calcareous; moderately alkaline (pH 8.2); gradual, smooth boundary.

C--18 to 30 inches, light brownish-gray (2.5Y 6/2) gravelly loam, grayish brown (2.5Y 5/2) when moist; massive; hard, very friable; 25 percent limestone gravel and channers; calcareous; moderately alkaline (pH 8.2); abrupt, wavy boundary.

R--30 to 60 inches, limestone.

The A horizon ranges from 6 to 16 inches in thickness and from gravelly loam to gravelly clay loam in texture. The AC and C horizons range from 14 to 24 inches in thickness and from gravelly loam to gravelly clay loam in texture. Gravel content ranges from 15 to 35 percent. Depth to bedrock is from 20 to 40 inches.

Tarryall gravelly loam, 10 to 50 percent slopes (TaF).--This moderately steep to very steep soil is on hills and ridges along the front range in the western part of the Area. Most mapped areas are long and narrow and are not extensive.

Included with this soil in mapping are areas of a soil that is similar except for having bedrock at a depth of 20 inches or less. This soil is on ridgetops. Also included are small areas of Satanta loam, calcareous variant, 9 to 25 percent slopes, and some limestone outcrops and cliffs.

Runoff is rapid. The erosion hazard is moderate. Soil slippage takes place on the steeper slopes.

All areas of this soil are grazed by livestock and wildlife. (Capability unit VIIe-1; Shallow Foothill range site)

Tinytown Series

The Tinytown series consists of well-drained soils that formed in alluvium derived from weathered, reddish-brown, arkosic sedimentary rock. These sloping to steep soils are on uplands and foot slopes. Slopes are 5 to 30 percent. The vegetation is mid grasses. Elevations are 6,200 to 8,000 feet. Annual precipitation is 15 to 20 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 125 days or less.

In a representative profile the surface layer, about 12 inches thick, is weak-red and reddish-brown gravelly sandy loam. The subsoil is weak-red gravelly sandy loam about 8 inches thick. The underlying material is reddish-brown gravelly sandy loam that extends to a depth of 60 inches or more.

Tinytown soils have moderately rapid permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Tinytown soils are in native grass and are used for grazing livestock. They are also a source of material for road fill.

Representative profile of a Tinytown gravelly sandy loam, 1,200 feet north and 300 feet east of the southwest corner of the southeast quarter of sec. 32, T. 10 S., R. 67 W.:

A11--0 to 6 inches, weak-red (2.5YR 4/2) gravelly sandy loam, very dusky red (2.5YR 2/2) when

moist; moderate, fine, granular structure; soft, very friable; 20 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); clear, smooth boundary.

A12--6 to 12 inches, reddish-brown (2.5YR 5/3) gravelly sandy loam, dark reddish brown (2.5YR 3/3) when moist; moderate, medium, subangular blocky structure; hard, very friable; 20 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); clear, smooth boundary.

B2--12 to 20 inches, weak-red (10R 5/4) gravelly sandy loam, weak red (10R 4/4) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, very friable; 30 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8); gradual, smooth boundary.

C--20 to 60 inches, reddish-brown (2.5YR 5/4) gravelly sandy loam, reddish brown (2.5YR 4/4) when moist; 30 percent fine and very fine, angular, granitic gravel; neutral (pH 6.8).

The A horizon ranges from 7 to 20 inches in thickness. The B horizon ranges from 6 to 16 inches in thickness. The C horizon ranges from gravelly loam to gravelly loamy sand in texture and contains 15 to 35 percent gravel. Depth to bedrock is 40 inches or more.

Tinytown-Cheeseman complex, 5 to 30 percent slopes (TcE).--This complex is an intricate intermingling of about 50 percent Tinytown gravelly sandy loam, about 35 percent Cheeseman loam, and 15 percent other soils. These sloping to steep soils are on uplands and foot slopes in the southwestern part of the Area. In a typical area, the Tinytown soils are at higher elevations than the Cheeseman soils.

Included with these soils in mapping are small areas of Garber gravelly sandy loam, 5 to 30 percent slopes, Perrypark sandy loam, 3 to 20 percent slopes, and a few rock outcrops. Also included are eroded areas in old cultivated fields that have gullies 2 to 4 feet deep at intervals of 200 to 300 feet.

Runoff is medium to rapid. The erosion hazard is slight to moderate.

Most areas of these soils are in native grass and brush. Gambel oak and mountain-mahogany are common. These areas are mostly used for grazing livestock. A few areas that were once cultivated are reseeded to grass. (Capability unit VIe-3; Loamy Park range site)

Tomah Series

The Tomah series consists of well-drained soils that formed in alluvium derived from weathered arkosic sedimentary rock. These gently rolling to moderately steep soils are on upland alluvial fans and hills and ridges. Slopes are 5 to 25 percent. The vegetation is mid and tall grasses. Elevations are 6,600 to 8,000 feet. Annual precipitation is 17 to 21 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 115 to 125 days.

In a representative profile the surface layer, about 11 inches thick, is dark grayish-brown fine sandy loam. The next layer, about 6 inches thick, is light-gray loamy sand. The subsoil, about 33 inches thick, is light-gray and yellowish-brown sand containing bands of brown sandy clay loam 1/4 to 3 inches thick. The underlying material is pale-brown loamy sand that extends to a depth of 60 inches or more.

Tomah soils have moderate permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Most areas of Tomah soils are in native grasses, Gambel oak, and a few scattered ponderosa pine. They are used for grazing, recreation, and wildlife habitat and are a source of material for road fill. Urban development is taking place in some areas.

The Tomah soils in the Area are mapped only in a complex with Crowfoot soils. This mapping unit is described under the heading "Crowfoot Series."

Representative profile of a Tomah fine sandy loam, 1,800 feet north of the southeast corner of sec. 34, T. 10 S., R. 66 W.:

A1--0 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, very friable; 10 percent gravel; slightly acid (pH 6.2); clear, smooth boundary.

A2--11 to 17 inches, light-gray (10YR 7/2) loamy sand, brown (10YR 5/3) when moist; weak, medium, platy structure parting to single grain; hard, loose; vesicular; 10 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.3); clear, wavy boundary.

A&B--17 to 22 inches, variegated colors, light-gray (10YR 7/2) and yellowish-brown (10YR 5/4) loamy sand with nodules and seams of sandy clay loam; brown (10YR 5/3) to yellowish brown (10YR 5/4) when moist; weak, fine, subangular blocky structure; very hard, very friable; thin patchy clay films on sandy clay loam nodules; 10 percent, fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); gradual, wavy boundary.

B&A--22 to 50 inches, yellowish-brown (10YR 5/4) sand with many thin seams and lamellae of sandy clay loam, dark yellowish brown (10YR 4/4) when moist; moderate, fine, subangular blocky structure; extremely hard, very friable; thin nearly continuous clay films on faces of peds in the bands and lamellae; 10 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); diffuse, wavy boundary.

C--50 to 60 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) when moist; massive; very hard, very friable; 10 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4).

The A1 horizon ranges from 8 to 18 inches in thickness and from fine sandy loam to loamy sand in texture. The A2 horizon ranges from 3 to 20 inches in thickness. The B&A horizon ranges from 20 to 60 inches in thickness, and the bands range from 1/4 inch to 6 inches in thickness. Material separating the bands ranges from sandy loam to sand in texture. Gravel content throughout the soil ranges from 0 to 20 percent.

Truckton Series

The Truckton series consists of well-drained soils that formed in alluvium derived from weathered arkosic sedimentary rock that in many places has been reworked by wind. These gently undulating to hilly soils are on uplands. Slopes are 1 to 25 percent. The vegetation is mid and tall grasses. Elevations are 5,500 to 6,600 feet. Annual precipitation is 15 to 19 inches. Mean annual soil temperature is 49° to 54° F., and the frost-free season is 120 to 135 days.

In a representative profile, the surface layer, about 4 inches thick, is dark-brown sandy loam. The subsoil is brown and light yellowish-brown sandy loam about 15 inches thick. The underlying material is very pale brown sandy loam extending to a depth of 60 inches or more.

Truckton soils have moderately rapid permeability. Available water capacity is moderate. Plants can penetrate to a depth of 40 inches or more.

Most areas of Truckton soils are in native grasses and are used for grazing. Some areas are cultivated, mostly for growing dryfarmed crops, but some areas are irrigated.

Representative profile of a Truckton sandy loam, in native pasture, 1,650 feet south and 800 feet west of the northeast corner of sec. 3, T. 7 S., R. 66 W.:

A1--0 to 4 inches, dark-brown (10YR 4/3) sandy loam, very dark brown (10YR 2/3) when moist; weak, medium, subangular blocky structure; hard, very friable; neutral (pH 6.8); clear, smooth boundary.

B2t--4 to 12 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, medium to coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, very friable; thin patchy clay films on vertical and horizontal faces of peds; neutral (pH 6.8); clear, smooth boundary.

B3--12 to 19 inches, light yellowish-brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) when moist; weak, medium to coarse, prismatic structure; very hard, very friable; few, thin, patchy clay films on vertical faces of peds; neutral (pH 6.8); gradual, smooth boundary.

C--19 to 60 inches, very pale brown (10YR 7/4) light sandy loam grading to sand with depth, light yellowish brown (10YR 6/4) when moist; massive to single grain; very hard to loose, very friable to loose; neutral (pH 6.8).

The A horizon ranges from 4 to 20 inches in thickness, except in some eroded areas, where it is missing. The B horizon ranges from 8 to 30 inches in thickness.

Truckton sandy loam, 1 to 3 percent slopes (TrB).--This gently undulating soil is on uplands in the northwestern part of the Area. Most mapped areas are generally 20 to 50 acres in size.

This soil has a profile similar to that described as representative for the series, except that in the lower lying areas the surface layer ranges from 7 to 20 inches in thickness. The subsoil is about 12 inches thick.

Included with this soil in mapping are small areas of Bresser sandy loam, 1 to 3 percent slopes, Blakeland sandy loam, 1 to 15 percent slopes, and Truckton sandy loam, 3 to 8 percent slopes. A few wet-weather lakes are present, and in a few places a buried soil is at a depth of about 32 inches.

Runoff is slow. The hazard of soil blowing is moderate, and the water erosion hazard is slight.

Most areas of this soil are cultivated and used for growing both dryland and irrigated crops. (Capability unit IIIe-1, dryland; IIe-2, irrigated; Sandy Foothill range site)

Truckton sandy loam, 3 to 8 percent slopes (TrD).--This rolling soil is in the northern part of the Area on uplands. Most mapped areas are generally not more than 40 acres in size.

Included with this soil in mapping are small areas of Bresser sandy loam, 3 to 9 percent slopes, and Blakeland sandy loam, 1 to 15 percent slopes. Also included are a few small areas that have sandstone or shale at a depth of less than 40 inches, and small areas along drainageways that are darker colored than this Truckton soil.

Runoff is slow to medium. The hazard of soil blowing and water erosion is moderate. Some gullies are present.

About half of the soil areas are in native grass and are used for grazing. The rest are cultivated to both dryland and irrigated crops. In most places irrigation is by sprinklers. (Capability Unit IVe-4, dryland; IVe-2, irrigated; Sandy Foothill range site)

Westcreek Series

The Westcreek series consists of well-drained soils that formed in alluvium derived from weathered arkosic sedimentary rock or granitic rock. These moderately steep to steep soils are on side slopes or upland hills and ridges. Slopes are 10 to 30 percent. The vegetation is mid and tall grasses, Gambel oak, and a few ponderosa pine. Elevations are 7,000 to more than 8,000 feet. Annual precipitation is 18 to 22 inches. Mean annual soil temperature is 44° to 46° F., and the frost-free season is 120 days or less.

In a representative profile the surface layer, about 10 inches thick, is grayish-brown gravelly

loam. The next layer is light brownish-gray gravelly sandy loam. The subsoil, about 32 inches thick, is brown gravelly sandy clay loam. The underlying material is brown gravelly sandy loam extending to a depth of 60 inches or more.

Westcreek soils have moderately slow permeability. Available water capacity is moderate. Plants can penetrate to a depth of 60 inches or more.

Areas of Westcreek soils are in native grasses and are used for grazing and wildlife habitat.

Representative profile of a Westcreek gravelly loam, on the north side of Colorado State Highway No. 67, approximately 300 feet east of the entrance of the Woodbine Lodge in sec. 6, T. 8 S., R. 68 W.:

A1--0 to 10 inches, grayish-brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; 15 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); clear, smooth boundary.

A2--10 to 16 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, grayish brown (10YR 5/2) when moist; moderate, very fine, subangular blocky structure parting to strong, very fine, granular; soft, very friable; 20 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); clear, smooth boundary.

A&B--16 to 21 inches, light brownish-gray (10YR 6/2) gravelly heavy sandy loam with nodules and lamellae of brown (7.5YR 5/2) gravelly sandy clay loam; brown (7.5YR 5/2) when crushed, grayish brown (10YR 5/2) and dark brown (7.5YR 3/2) when moist, brown (7.5YR 4/2) when moist and crushed; weak, fine, subangular blocky structure; hard, friable; 30 percent fine and very fine, angular, granitic gravel; neutral (pH 6.6); gradual, wavy boundary.

B2t--21 to 48 inches, brown (7.5YR 5/2) gravelly sandy clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; extremely hard, friable; thin continuous clay films on faces of soil aggregates; many channel fillings of silicate clay; 30 percent fine and very fine, angular, granitic gravel; slightly acid (pH 6.4); gradual, wavy boundary.

C--48 to 60 inches, brown (7.5YR 5/4) gravelly sandy loam, brown (7.5YR 5/4) or dark brown (7.5YR 4/4) when moist; massive to single grain; very hard, very friable; 30 percent, fine and very fine, angular, granitic gravel; slightly acid (pH 6.6).

The dark-colored A1 horizon ranges from 6 to 14 inches in thickness. The light-colored A2 horizon ranges from 3 to 12 inches in thickness and from gravelly loam to gravelly sandy loam in texture. The B2t horizon ranges from 10 to 60 inches in thickness and from gravelly loam to gravelly clay loam in texture. Depth to bedrock is more than 40 inches.

Westcreek gravelly loam, 10 to 30 percent slopes (WeE).--This moderately steep to steep soil is in the western part of the Area.

Included with this soil in mapping are small areas of Garber gravelly sandy loam, 5 to 30 percent slopes, Juget soils, and Rock outcrop.

Runoff is medium to rapid. The erosion hazard is moderate to high. Gullies are in drainageways. Soil slippage takes place on the steeper slopes.

All areas of this soil are in native grass and are used for livestock and wildlife grazing. Some Gambel oak and ponderosa pines are present. (Capability unit VIe-3; Loamy Park range site)

This section consists of several parts. The first discusses the general practices for crops and pasture, explains the capability classification of soils, describes each capability unit in the Castle Rock Area, and gives predicted yields of major crops. Other parts discuss use of the soils for range, woodland, recreation, wildlife, engineering, and town and country planning.

General Management of Crops and Pasture [2/]

This section discusses the management of all the irrigated and dryland soils in the Castle Rock Area when used for cropland, hayland, or pasture.

Management of Irrigated Soils

The most important irrigated crops in the Castle Rock Area are alfalfa, corn, and small grain. The more nearly level loams, sandy loams, and clay loams do not require special crops or crop rotations. These soils are suited to intensive cropping, including growing of vegetable crops, but are mainly used to produce feed crops and pasture for livestock. The common rotation is alfalfa for 4 years, corn, small grain, corn, and then back to alfalfa. The finer textured soils are suited to grain crops that produce large quantities of crop residue, or are suited to alfalfa and grass. Soils with steeper slopes are better protected when they are kept in alfalfa or permanent hay or pasture.

Under good management the crops grown in the Area respond well to irrigation, but in irrigated areas, practices are needed that protect the soils, conserve water, and help to maintain good tilth and the content of organic matter. Other good practices consist of fertilizing the soils and of using good methods for irrigating.

In the Castle Rock Area, the drilled crops (hay and grain) are suited to border, border ditch, contour ditch, and sprinkler methods of irrigation. On the more clayey soils corrugations work well. Furrow irrigation is used where row crops are grown. Where the soils are sandy or sloping, the length of run needs to be shortened. Other practices that may be needed are lining the ditches with concrete, constructing structures that divide a head of water or that direct water from one ditch to another, and using a Parshall flume or other measuring device that will indicate how much water is being used.

The farmer who irrigates his soils needs to be able to apply water uniformly and to conserve water and labor. Land leveling helps to do these things, and it is necessary if border irrigation is used. On level land, irrigation runs can be long and larger irrigation heads can be used. Land leveling is not so necessary in areas that are sprinkler irrigated as it is in areas that are surface irrigated.

On irrigated soils, fertility must be kept at a high level if high yields are to be obtained. This can be done by plowing under clover or the last cutting of hay, by applying barnyard or feedlot manure, or by returning all crop residue to the soil. Applying such commercial fertilizers as nitrogen and phosphate help increase plant growth. Before commercial fertilizer or barnyard manure is applied, however, the soils should be tested. The county agent can give assistance in testing the soils.

Management of Irrigated Pasture and Hayland

Land not suited to irrigated crops can be productive when seeded to permanent grass or grass-legume mixtures for hay, pasture, or seed production. Suitable grasses for irrigated soils are smooth brome, orchardgrass, the fescue grasses, and the wheat grasses. Adding legumes to pasture and hay mixtures increases productivity, but where the pasture is grazed, there is a hazard of cattle bloating. Alfalfa and red or alsike clover are suitable legumes for planting for hay. Alfalfa, ladino clover, and yellow sweetclover are suitable legumes for pasture. Wheatgrass is well suited to the more clayey soils, and tall wheatgrass is well suited to salty or alkaline soils. The pasture should be rotated to allow for good management of irrigation water and to allow for periods of regrowth. Proper management will limit grazing so that the cover is maintained or increased and the soil is protected from erosion. Overirrigating encourages the growth of less palatable and less productive plants, and where pasture is depleted, renovation or plowing and reseeding may be needed.

Management of Dryland Soils

In the Castle Rock Area, land that is not suited or is poorly suited to crops may be most easily protected and made more productive by seeding permanent grass and grazing the seeded range or pasture. Soils that are dryfarmed need management that helps conserve moisture, control soil blowing and water erosion, and maintain fertility.

On nearly all of the dry cropland in the Area, the basic rotation is one of winter wheat-fallow. Wheat is planted in late summer or fall, harvested the next summer, and the field fallowed next spring and summer, and planted back to wheat. Where wheat allotments are limited, forage sorghum, barley, oats, and rye are grown on some of the cropland.

A system of summer fallow is commonly used because it conserves moisture. In this system crops are

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2/ JAMES G. BRUNER, conservation agronomist, Soil Conservation Service, helped prepare this section.

grown only in alternate years and stubble mulching is generally practiced in the intervening years. On soils that are sandy or that are sloping and tend to erode, managing crops and crop residues is necessary on a year round basis.

During winter and spring, protective amounts of crop residue are kept on or near the surface so as to protect the idle soils from soil blowing and water erosion. This practice is suited to less erodible clays, clay loams, loams, and sandy loams that are relatively level. Crop residue can be maintained by limiting the number of tillage operations and by using subsurface implements.

Other practices used are contour planting or stripcropping across the slope or across the direction of damaging winds; terracing on clay loams and loams that are sloping; building diversions that protect the soil from surface runoff; controlling gully erosion; establishing grassed waterways and outlets; and chiseling on soils that tend to develop tillage pans. Emergency tillage or soil roughing is necessary where the soil has begun to blow.

Management of Nonirrigated Pasture and Hayland

Land that is planted to pasture or hay is most productive when properly used and managed. Grazing should be discontinued before the pasture grasses have stopped growing. Such grasses as crested wheatgrass and Russian wildrye will take close grazing. Protective amounts of stubble should be kept on the surface. On tall grasses, such as brome, intermediate wheat, and tall wheat, a minimum of 4 inches of stubble should be left.

Capability Grouping [3/]

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use. (There are no class I soils in this survey area.)
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (There are no class VIII soils in this survey area.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have

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3/ T. M. STINSON, work unit conservationist, Soil Conservation Service, helped prepare this section.

similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIs-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by Dryland and Irrigated Capability Units

In the following pages the capability units in the Castle Rock Area are described and suggestions for the use and management of the soils are given. The soil series represented in each unit are named, but this does not mean that all the soils of the series are in the unit. To find the unit in which a given soil has been placed, refer to the "Guide to Mapping Units" at the back of this survey.

Capability Unit IIe-1, Irrigated

This unit consists of well-drained soils of the Fondis, Sampson, and Satanta series. These soils have a loam and clay loam surface layer and a clay loam or clay subsoil. Slopes are 1 to 4 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days. Permeability is moderate to slow. Runoff is medium to slow, and the erosion hazard is slight to moderate. Water erosion is a hazard where water from higher areas runs onto these soils. Available water capacity is high. The effective rooting depth is more than 60 inches.

These soils are used mainly for corn for silage, small grain, forage sorghum, pasture, and alfalfa for hay.

A suitable conservation cropping system is corn for silage followed by small grain and then alfalfa. Organic-matter content can be maintained by returning all crop residue to the soil. Land leveling improves surface irrigation. Irrigation runs can be long. Chiseling to a depth of 12 inches when the soil is dry breaks plowpans and improves water intake and conditions for root growth. Crops respond to nitrogen and phosphorus fertilizers.

Capability Unit IIe-2, Irrigated

This unit consists of well-drained soils of the Bresser and Truckton series. These soils have a sandy loam surface layer and a sandy clay loam or sandy loam subsoil. Slopes are 1 to 3 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is moderate to moderately rapid. Runoff is slow, and the erosion hazard is slight to moderate. Available water capacity is moderate. The effective rooting depth is more than 60 inches. These soils are easy to cultivate, but the surface crusts when dry and restricts seedling emergence.

The soils of this capability unit are used mainly for corn for silage, small grain, forage sorghum, pasture, and alfalfa for hay.

A suitable conservation cropping system is corn for silage followed by small grain and then alfalfa for 3 to 5 years. Organic-matter content can be maintained by returning all crop residue to the soil and by applying barnyard manure. Land leveling improves surface irrigation. Irrigation runs can be of moderate length. Sprinkler irrigation is necessary for uniform application of water. Seedling emergence is aided by breaking the surface crust or irrigating. Crops respond to nitrogen and phosphorus fertilizers.

Capability Unit IIIe-1, Dryland

This unit consists of well-drained soils of the Bresser and Truckton series. These soils have a sandy loam surface layer and a sandy clay loam or sandy loam subsoil. Slopes are 1 to 3 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is moderate to moderately rapid. Runoff is slow, and the erosion hazard is slight to moderate. Available water capacity is moderate. The effective rooting depth is more than 60 inches. These soils are easy to cultivate, but the surface crusts when dry and restricts seedling emergence.

The soils of this capability unit are used mainly for wheat, small grain, forage sorghum, and pasture. Alfalfa is grown in some areas, but yields are low and stands thin out in 3 or 4 years.

Summer fallow is a common practice. Use of crop residue conserves moisture and helps control erosion. Stripcropping using a minimum amount of tillage helps control soil blowing. Crops respond to nitrogen and phosphorus fertilizers.

Capability Unit IIIs-1, Irrigated

Only Englewood clay loam is in this capability unit. This well-drained soil has a clay loam surface layer and a clay subsoil. Slopes are 1 to 4 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days. Permeability is very slow. Runoff is medium, and the erosion hazard is slight. Available water capacity is high. The effective rooting depth is more than 60 inches.

The soil of this capability unit is used mainly for pasture, alfalfa, corn for silage, and small grain.

Organic-matter content can be maintained by returning all crop residue to the soil and applying

barnyard manure. Irrigation water must be managed so that seep spots are prevented and salts are not allowed to accumulate. Land leveling improves surface irrigation and prevents ponding. Irrigation runs can be relatively long. Chiseling to a depth of 16 inches when the soil is dry breaks plowpans and improves water intake and conditions for root growth. Crops respond to nitrogen and phosphorus fertilizers.

Capability Unit IIIc-1, Dryland

This unit consists of well-drained soils of the Brussett, Fondis, Peyton, Sampson, and Satanta series. These soils have a loam, sandy loam, or clay loam surface layer and a clay loam, sandy clay loam, or clay subsoil. Slopes are 1 to 4 percent. Annual precipitation is 15 to 21 inches, and the frost-free season is 115 to 135 days.

Permeability is moderate to slow. Runoff is medium to slow, and the erosion hazard is slight to moderate. Available water capacity is high. The effective rooting depth is 40 to 60 inches. These soils are easy to cultivate, but plowpans form where the soils are too wet.

The soils of this capability unit are used mainly for wheat and barley, but a few areas are in native grass.

A suitable conservation cropping system is winter wheat or barley followed by summer fallow. Organic-matter content can be maintained by returning all crop residue to the soil. Use of crop residue conserves moisture and helps control erosion. Chiseling to a depth of 12 inches when the soil is dry breaks plowpans. Crops respond to nitrogen fertilizer when precipitation is normal or above normal. During some years, crops on the Brussett and Peyton soils are affected by late spring frost or early summer frost.

Capability Unit IVe-1, Irrigated

This unit consists of well-drained soils of the Buick, Fondis, and Satanta series and the Satanta series, calcareous variant. These soils have a loam and clay loam surface layer and a clay loam and clay subsoil. Slopes are 3 to 9 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is slow to moderate. Runoff is medium, and the erosion hazard is moderate. Available water capacity is high. The effective rooting depth is more than 60 inches.

These soils are used mainly for irrigated pasture and alfalfa, but small grain and corn are grown in some areas. These soils are well suited to irrigated grass pasture. A suitable pasture planting is a mixture of intermediate wheatgrass, smooth bromegrass, orchardgrass, and ladino or alsike and red clover.

Organic-matter content can be maintained by returning all crop residue to the soil and applying barnyard manure. Planting on the contour and irrigating with ditches having a gradient that does not encourage movement of soil material are ways to control erosion. Land smoothing improves irrigation. Irrigation runs can be short. Sprinkler irrigation is desirable. Chiseling to a depth of 12 inches when the soils are dry breaks plowpans and improves water intake and conditions for root growth. Crops respond to nitrogen and phosphorus fertilizers.

Capability Unit IVe-2, Irrigated

This unit consists of well-drained soils of the Bresser and Truckton series. These soils have a sandy loam surface layer and an underlying layer or subsoil of sandy clay loam or sandy loam. Slopes are 3 to 9 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is moderate to moderately rapid. Runoff is medium to slow, and the erosion hazard is moderate. Available water capacity is moderate. The effective rooting depth is more than 60 inches.

The soils of this capability unit are used mainly for grass and alfalfa for pasture and hay. Some corn for silage is grown. These soils are well suited to irrigated grass pasture. A suitable pasture planting is a mixture of intermediate wheatgrass, smooth bromegrass, orchardgrass, and ladino, alsike, or red clover.

Organic-matter content can be maintained by returning all crop residue to the soil and applying barnyard manure. Because the soils are sloping, proper management of irrigation water is difficult. Sprinkler irrigation is suggested. Planting on the contour and irrigating with ditches that are constructed on a grade that will not erode when the water flows in them are ways to control erosion. Land smoothing improves surface irrigation, but is limited in the Bresser soils by the depth of cuts that can be safely made. Crops respond to nitrogen and phosphorus fertilizers.

Capability Unit IVe-3, Dryland

This unit consists of well-drained soils of the Brussett, Buick, Cruckton, Fondis, Kutch, Manzanola, Peyton, Rednum series and the Satanta series, calcareous variant. These soils have a sandy loam, loam, and clay loam surface layer and a sandy loam, sandy clay loam, clay loam, or clay subsoil. Slopes are 1 to 10 percent. Annual precipitation is 15 to 21 inches, and the frost-free season is 115 to 135 days.

Permeability is moderate to slow. Runoff is medium to rapid, and the erosion hazard is slight to moderate. Available water capacity is high, except in Kutch clay loam, 3 to 9 percent slopes, where it

is moderate. The effective rooting depth is 40 to 60 inches in all except the Kutch soil. For that soil the rooting depth is 20 to 40 inches.

The Kutch soil has properties somewhat different from those of other soils in this capability unit, but management practices are similar.

The soils of this capability unit are used mainly for wheat, but barley is grown in some areas. These soils are well suited to permanent grass pasture. A suitable pasture planting is intermediate or pubescent wheatgrass.

Summer fallow is a common practice. Stubble-mulch tillage conserves moisture, helps maintain organic-matter content, and helps control erosion. Fertility can be maintained, if erosion is controlled. Terracing combined with grassed waterways and planting on the contour help control erosion. Chiseling to a depth of 12 inches when the soil is dry breaks plowpans and improves water intake and conditions for root growth.

Capability Unit IVe-4, Dryland

This unit consists of well-drained soils of the Bresser and Truckton series. These soils have a sandy loam surface layer and an underlying layer or subsoil of sandy clay loam or sandy loam. Slopes are 3 to 9 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is moderate to moderately rapid. Runoff is slow to medium, and the erosion hazard is moderate. Available water capacity is moderate. The effective rooting depth is more than 60 inches.

The soils of this capability unit are used mainly for wheat, barley, sorghum, and corn. Alfalfa is grown in some areas, but yields are low and stands thin out in 3 or 4 years. These soils are well suited to permanent grass pasture. A suitable pasture planting is intermediate or pubescent wheatgrass.

Summer fallow is a common practice. Organic-matter content can be maintained by returning all crop residue to the soil. Stubble-mulch tillage helps keep the surface from crusting and controls erosion. Stripcropping and terracing combined with grassed waterways help control erosion. Crops respond to nitrogen fertilizer when precipitation is normal or above normal.

Capability Unit IVe-5, Dryland

This unit consists of well drained and somewhat excessively drained soils of the Blakeland and Orsa series. These soils have a sandy loam or loamy sand surface layer and an underlying layer of sandy loam or loamy sand. Slopes are 1 to 4 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is rapid. Runoff is slow to medium, and the erosion hazard is slight to moderate. Soil blowing is the greatest hazard. Available water capacity is moderate. The effective rooting depth is more than 60 inches.

The soils of this capability unit are used mainly for forage sorghum, small grain, and pasture. They are well suited to permanent grass pasture. A suitable pasture planting is intermediate or crested wheatgrass.

Summer fallow is not beneficial on these soils. Use of crop residue helps maintain organic-matter content. Soil blowing can be controlled by keeping a permanent cover on the soils. Diversions help protect these soils from runoff and help control erosion. Crops respond to nitrogen fertilizer when precipitation is normal or above normal.

Capability Unit IVw-1, Dryland

This unit consists of Loamy alluvial land, dark surface, and Peyton sandy loam, wet, 1 to 5 percent slopes. These poorly drained and well-drained soils have a surface layer of loam and sandy loam and an underlying layer or subsoil of sandy loam or clay loam. Slopes are 0 to 5 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 115 to 135 days. Permeability is moderate. Runoff is slow or medium, and the erosion hazard is slight to moderate. Most of the erosion is caused by water runoff from higher areas. Available water capacity is high. A water table is not present, except along the South Platte River, where it is at a depth of less than 2 feet, and in the Peyton soil, where it is below a depth of 3 feet. The effective rooting depth is more than 36 inches.

The soils of this capability unit are used mainly for wheat and grass pasture. Alfalfa for pasture and hay is also grown. Many areas previously farmed have been reseeded for pasture and hay. A suitable pasture planting is a mixture of intermediate wheatgrass and alfalfa.

Diversion terraces with grassed waterways help reduce erosion by controlling runoff from high areas.

Capability Unit IVs-1, Irrigated

This unit consists of well drained to somewhat excessively drained soils of the Blakeland, Kassler, and Orsa series. These soils have a sandy loam or loamy sand surface layer and an underlying layer of sandy loam or loamy sand. Slopes are 1 to 4 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days. Permeability is rapid. Runoff is slow to medium, and the erosion hazard is slight to moderate. Soil blowing is the greatest hazard. Available water capacity is moderate. The effective rooting depth is more than 60 inches.

The soils of this capability unit are well suited to irrigated grass and legume pasture. Suitable pasture grasses and legumes are smooth bromegrass, intermediate wheatgrass, orchardgrass, alfalfa, and alsike and red clover.

These soils are well suited to sprinkler irrigation. Light, frequent irrigations are needed. Crops respond to nitrogen fertilizer.

Capability Unit IVs-2, Dryland

Only Englewood clay loam is in this capability unit. This well-drained soil has a clay loam surface layer and a clay subsoil. Slopes are 1 to 4 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is slow. Runoff is medium, and the erosion hazard is slight. Available water capacity is high. The effective rooting depth is more than 60 inches.

The soil of this capability unit is used mainly for wheat and grass pasture. It is well suited to permanent grass pasture. A suitable pasture planting is intermediate wheatgrass or Russian wildrye.

A suitable conservation cropping system is wheat followed by summer fallow. This soil is difficult to cultivate when moist. Crops respond to nitrogen fertilizer when precipitation is normal or above normal.

Capability Unit Vw-1, Dryland

Only Loamy wet alluvial land is in this unit. This poorly drained stratified land type has a sandy loam and clay loam surface layer and an underlying layer of sand or clay. Slopes are 1 to 5 percent. Annual precipitation is 15 to 19 inches, and the frost-free season is 115 to 120 days.

Permeability is moderately slow. Runoff is slow, and the erosion hazard is high. Available water capacity is moderate to high. The effective rooting depth is more than 60 inches. The seasonal high water table is at a depth of less than 5 feet, and in the spring, water is at the surface.

This soil is used mainly for meadow grasses for pasture and hay. In the wetter areas, rushes and sedges replace grass.

Establishing grass is difficult because of the high water table and the frequent flooding. Broadcast seeding is sometimes beneficial. Surface ditches that lead water away from low spots help prevent ponding and encourage grasses to grow. Grasses respond to nitrogen fertilizer.

Capability Unit VIe-1, Dryland

This unit consists of well-drained soils of the Buick, Denver, Fondis, Heldt, Kutch, Manzanola, Razor, Rednun, Redridge, Renohill series, and Renohill series, reddish variant. Most of these soils have a clay loam surface layer and a clay and heavy clay loam subsoil. They are mostly sloping to steep. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is slow. Runoff is rapid to slow, and the erosion hazard is slight to high. Available water capacity is moderate to high. The effective rooting depth is more than 20 inches.

Kutch sandy loam, 5 to 20 percent slopes, and Renohill sandy loam, reddish variant, 5 to 25 percent slopes, have soil properties somewhat different from those of other soils in this capability unit, but management practices are similar. Buick and Redridge soils are included because they are mapped in a complex with Renohill and Rednun soils, respectively.

The soils of this capability unit are used mainly for grazing livestock. Areas once cultivated have been seeded to grass or allowed to return to native grass. A suitable pasture planting is intermediate wheatgrass or pubescent wheatgrass.

Where slopes are less than 15 percent, grass can be planted in narrow strips on the contour. Native grasses can be allowed to grow between the reseeded strips. A firm seedbed is necessary for reseeding. Contour furrowing and pitting help reduce erosion, especially along areas that are close to watering places where gullies form along stock trails. These practices can also be effective in reducing surface runoff and in trapping snow. Most ponds or dams do not need to be sealed to hold water.

Capability Unit VIe-2, Dryland

This unit consists of well-drained soils of the Bresser, Chaseville, Gove, Newlin, Redridge, Santanta, Stapleton, and Truckton series. The Louviers soils are included in this capability unit, but only because they are mapped in complex with Bresser soils. These soils have a sandy loam and gravelly sandy loam surface layer and a clay, sandy clay loam, and sandy loam subsoil. The content of gravel in the subsoil can be as much as 35 percent. The soils are mostly sloping to steep. Annual precipitation is 15 to 19 inches, and the frost-free season is 115 to 135 days.

Permeability is moderate to moderately rapid. Runoff is medium to very rapid, and the erosion hazard is slight to high. Available water capacity is low to high. The effective rooting depth is more than 20 inches. On overgrazed areas or on areas that were once cultivated, fertility is low and soil blowing and water erosion are hazards.

The soils of this capability unit are used for pasture and for grazing livestock. Suitable grasses for pasture planting are intermediate wheatgrass and pubescent wheatgrass.

Areas that were once cultivated or areas that are overgrazed should be reseeded to grass. Contour furrowing and diversions help control erosion. Pitting will trap snow and aid in reducing runoff and in controlling erosion. Most ponds that are used for stock water need to be sealed. Planted grasses respond to nitrogen fertilizer when precipitation is normal or above normal.

Capability Unit VIe-3, Dryland

This capability unit consists of well-drained soils of the Blakeland, Brussett, Cheeseman, Crowfoot, Cruckton, Jarre, Kippen, Perrypark, Peyton, Pring, Tinytown, Tomah, Truckton, and Westcreek series, and Satanta loam, calcareous variant, 9 to 25 percent slopes. These soils have a loam, gravelly loam, sandy loam, and gravelly sandy loam surface layer and a sandy loam, sandy clay loam, or gravelly sandy loam subsoil. Slopes range from nearly level to steep. Annual precipitation is 15 to 21 inches. The frost-free season of these soils is 115 to 135 days.

Permeability is moderate to moderately rapid. Runoff is medium to rapid, and the erosion hazard is slight to high. Available water capacity is moderate to high. The effective rooting depth is more than 60 inches.

The soils of this capability unit are used mainly for pasture and for grazing livestock. For pasture planting, smooth brome is the best adapted grass, but intermediate wheatgrass is also very good.

Eroded areas or areas that were once cultivated should be reseeded to grass. Planting in stubble protects the soils from erosion until grass is established. Contour furrows and diversions help control erosion. Planted grasses respond to nitrogen fertilizer when precipitation is normal or above normal.

Capability Unit VIe-4, Dryland

This unit consists of well drained and somewhat excessively drained soils of the Garber, Kassler, Kippen, Lonetree, Redtom, and Pring series. These soils have a loamy sand, gravelly, and very gravelly sandy loam surface layer and an underlying layer of very gravelly loamy sand or very gravelly sandy loam. In places some of the soils are eroded. Slopes are mostly sloping to steep. Annual precipitation is 15 to 21 inches, and the frost-free season is 115 to 125 days.

Permeability is rapid. Runoff is slow to rapid, and the erosion hazard is slight to high. Available water capacity is moderate. The effective rooting depth is 40 to 60 inches.

The soils of this association are used mainly for pasture and for grazing livestock. Smooth brome and intermediate wheatgrass are suitable grasses.

Stock-watering ponds seldom hold water. Wells and springs are available for stock water.

Capability Unit VIe-5, Dryland

This unit consists of well drained to somewhat excessively drained soils of the Kettle, Kutch, Larkson, Newlin, Plome, and Stapleton series. These soils have a sandy loam and loamy sand surface layer and a loamy sand, sandy clay loam, or sandy loam subsoil. They are mostly sloping to steep. Annual precipitation is 15 to 21 inches, and the frost-free season is 115 to 135 days.

Permeability is slow to moderately rapid. Runoff is slow to medium, and the erosion hazard is slight to moderate. Water erosion is the main hazard. Available water capacity is moderate to high. The effective rooting depth is more than 60 inches.

Larkson fine sandy loam, 3 to 9 percent slopes, and soils of the Kutch-Newlin-Stapleton complex have soil properties somewhat different from the other soils in this capability unit, but they are included because they are managed in a similar manner for wood production.

The soils in this capability unit have limited use for grazing livestock, but they are used as winter protection and summer shade for livestock. Some areas are logged for lumber. These areas are popular for homesites, and they are well suited to wildlife habitat and recreation.

Grass grows in areas that are cleared of trees, but overgrazing depletes the grass cover and increases the hazard of erosion. Access roads and skid trails need to be constructed on a grade that will not cause erosion.

Capability Unit VIw-1, Dryland

Only Loamy alluvial land is in this unit. This is a well-drained, stratified land type. It has a sandy loam and clay loam surface layer and an underlying layer of loamy sand or clay loam. It is nearly level to gently sloping. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is moderate. Runoff is medium, and the erosion hazard is moderate to high. Available water capacity is moderate to high. The effective rooting depth is more than 60 inches. This soil is flooded frequently with runoff from higher areas. Gullies will form where the soil is cultivated.

This soil is used mainly for grazing livestock.

Controlling erosion is difficult. Maintaining a permanent grass cover helps control erosion, and diversions and dams help divert runoff.

Capability Unit VIIe-1, Dryland

This unit consists of Coni, Lonetree, and Tarryall soils and Rock land. These soils are well drained and somewhat excessively drained. They have a surface layer and underlying layer of gravelly loam and loamy sand. They are steep to very steep. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is moderate to rapid. Runoff is rapid, and the erosion hazard is moderate. Available water capacity is low to moderate. The effective rooting depth is more than 20 inches. Soil slippage takes place on some of the steeper slopes.

Rock land makes up about 40 percent of the area of this capability unit. It consists of shallow associated soils and red sandstone that in many

areas stands as monuments and sentinels. Rock land is included because it is mapped in a complex with Lonetree soils. Use and management of this land type is based on the Lonetree soil.

The soils of this capability unit have limited use for grazing. They are suited to wildlife habitat and recreation.

Capability Unit VIIe-2, Dryland

This unit consists of somewhat excessively drained soils of the Falcon, Juget, and Kettle series. These soils have a loamy sand, sandy loam, and very gravelly sandy loam surface layer and a subsoil or underlying layer of gravelly sandy loam, very gravelly loamy sand, or coarse sand. Slopes are steep to very steep. Annual precipitation is 17 to 22 inches, and the frost-free season is 115 to 125 days.

Permeability is moderate to rapid. Runoff is medium to rapid, and the erosion hazard is slight to high. Available water capacity is low to moderate. The effective rooting depth is more than 10 inches. Depth to bedrock ranges from less than 20 inches to more than 60 inches. Rock outcrops are common.

The soils of this capability unit have limited use for grazing livestock. Some areas are logged for lumber, and some Christmas trees are cut. These areas are suited to wildlife habitat and recreation.

Access roads and skid trails need to be constructed on grades that will not erode.

Capability Unit VIIw-1, Dryland

This unit consists of Sandy alluvial land and Sandy wet alluvial land. These well-drained and poorly drained soils have a sand and loamy sand surface layer and an underlying layer of sandy loam or sand. Slopes are nearly level. Annual precipitation is 15 to 19 inches, and the frost-free season is 120 to 135 days.

Permeability is rapid. Runoff is slow, and the erosion hazard is moderate to high. Soil blowing is a problem on the barren sandy areas. Available water capacity is low. The effective rooting depth is more than 60 inches. The water table is at depths of 3 to 5 feet or more. Usually once every 5 years or less these soils are flooded during large storms. Channel changes and deposition of sand are common.

The soils of this capability unit have limited use for grazing livestock. They are not placed in a range site because the vegetation changes from flood to flood. Cottonwood and boxelder trees grow, and weeds are common. This is a source area for sand and gravel for construction purposes.

Diversions help control erosion and limit the amount of debris that is built up.

Capability Unit VIIs-1, Dryland

This unit consists of Stony rough land, Stony steep land, Stony steep land, cold, and Hilly gravelly land. These miscellaneous land types have a cobbly, flaggy, or stony clay loam and loamy sand surface layer and an underlying layer of cobbly clay loam or gravelly sandy loam. Shale, sandstone, or rhyolite is between depths of 10 and 40 inches. These land types are sloping to very steep. Annual precipitation is 15 to 22 inches, and the frost-free season is 115 to 135 days.

Permeability is moderate to moderately slow. Runoff is medium to rapid, and the erosion hazard is slight to high. Available water capacity is low to moderate. The effective rooting depth is 10 to 40 inches. Because of the amount of cobblestones and the depth to bedrock, some areas are droughty. Slippage takes place on some of the steeper slopes. Barren rock outcrop or cliffs are common.

The land types in this capability unit have limited use for grazing livestock, but they are well suited as a site for wildlife habitat or recreation.

Estimated Yields [4/]

The estimated yields in this soil survey are based on observations of soil scientists who surveyed the Area, on information furnished by farmers in the Area, and information from Colorado Agricultural Statistics publications. If no information was available for a particular soil, estimates were made for it by comparison with a similar soil for which yield data were available.

Table 2 gives estimates of yields for the principal dryland and irrigated crops grown in the Area. The management required to obtain the yields of dryland crops includes a grain-fallow cropping system; extensive use of crop residue; and stubble-mulch tillage during the fallow year. In addition, tillage operations are generally on the contour or across the slope; more attention is given to controlling weeds, disease, and insects; and recommended crop varieties are seeded at the proper time and rate and are harvested efficiently. Also, fertilizers are used on the sandy soils.

The management required to obtain the yields of irrigated crops includes a systematic cropping system in which alfalfa or grass, for hay or pasture, are grown for 3 to 5 years; then a crop of corn for silage, small grains, and back to alfalfa or grass. Fertilizers are applied according to soil tests and crop needs. Barnyard manure is applied when available. Irrigation water is adequate, and proper irrigation water management is used. Seedbed preparation is firm and smooth. Insects and weeds are controlled at the proper time.

Range

About 75 percent of the Castle Rock Area is used as range. The range vegetation consists of many

4/ WILLARD D. GRAVES and THOMAS K EAMAN, range conservationists, helped prepare this section.

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF PRINCIPAL DRYFARMED AND IRRIGATED CROPS

[Absence of yield means the crop is not suited to or is not commonly grown on the soil. Soils and land types that are not suited to cultivated crops are not included in the table]

Soil	Dryfarmed crops			Irrigated crops		
	Wheat	Barley	Oats	Corn (silage)	Alfalfa	Grass hay
	Bu.	Bu.	Bu.	Tons	Tons	Tons
Blakeland-Orsa association	20	20	---	16	4.0	3.0
Bresser sandy loam, 1 to 3 percent slopes	26	24	---	20	4.5	4.0
Bresser sandy loam, 3 to 9 percent slopes	20	20	---	---	3.5	3.5
Brussett loam, 1 to 3 percent slopes	23	--	30	---	---	---
Brussett loam, 3 to 9 percent slopes	20	--	25	---	---	---
Buick-Satanta loams, 3 to 9 percent slopes	19	19	---	---	3.5	3.5
Cruckton sandy loam, 1 to 9 percent slopes	20	--	25	---	---	---
Englewood clay loam	25	23	---	18	5.0	4.0
Fondis clay loam, 1 to 3 percent slopes	27	23	---	21	5.0	4.5
Fondis clay loam, 3 to 9 percent slopes	21	19	---	---	3.5	3.5
Kassler gravelly sandy loam	--	--	---	---	2.5	1.5
Kutch clay loam, 4 to 8 percent slopes	20	17	---	---	---	---
Manzanola clay loam	20	17	---	---	---	---
Peyton sandy loam, 1 to 3 percent slopes	23	--	32	---	---	---
Peyton sandy loam, 3 to 9 percent slopes	20	--	27	---	---	---
Rednun loam, 3 to 10 percent slopes	19	19	---	---	---	---
Sampson loam	27	23	---	21	5.0	4.5
Satanta loam	26	23	---	21	5.0	4.5
Satanta loam, calcareous variant, 3 to 9 percent slopes	20	17	---	---	3.0	1.5
Truckton sandy loam, 1 to 3 percent slopes	25	24	---	18	4.0	4.0
Truckton sandy loam, 3 to 8 percent slopes	19	19	---	---	2.5	3.5

kinds of native grasses, shrubs, and forbs that are suitable for grazing. Because the Area is between mountain to the west and broad plains to the east, conditions favor the growth of plants of both the mountains and plains.

Ranchers and farmers use the range for pasturing livestock primarily during the spring, summer, and fall. Some ranchers graze livestock the year around, except when a snow cover prohibits grazing in the winter. On many ranches, cropland, pasture, and woodland are used to supplement the rangeland forage and to provide year round forage for livestock.

Beef cattle, chiefly cows and calves, are the livestock most generally being pastured on the range. Saddle horses in increasing numbers are also users of rangeland. Most of these horses are for pleasure riding. Most of the range is also valuable for wildlife. Some deer are year round residents; others winter on the range in this county.

Ranchers and others using range need a controlled system of grazing that allows most efficient use of grasses and other plants on the range. For this purpose, the soils of this county have been placed in range sites. A range site has potential to produce a characteristic kinds and amount of native vegetation. When this potential is known, the present condition of the range can be compared with its potential to determine to what extent the range has deteriorated. With this knowledge, management can be planned that improves the condition of the range.

Range condition is rated in four classes: excellent, good, fair, and poor. Range in excellent condition is at or near potential for the range site on which it grows. The remaining three ratings indicate progressive deterioration of the range as a result of overgrazing or other undesirable land use.

For the most part, the range sites in this county are now producing 50 to 75 percent of their potential. Following are descriptions of these range sites. The soils in each site are listed in the "Guide to Mapping Units" at the back of this survey. The estimates of potential forage yield given in the range sites are based partly on yield records obtained by clipping and weighing, and partly on field estimates.

Clayey Foothill Range Site

This range site consists of moderately well drained and well drained soils that have a clay loam and clay surface layer and subsoil. Slopes are 0 to 25 percent. Annual precipitation is 15 to 19 inches. Permeability is moderate to slow.

Western wheatgrass and green needlegrass are the most important plants. They are dominant where this site is in excellent condition. Spike muhly, side-oats grama, and little bluestem also grow but are more difficult to maintain in the plant cover. Beard tongue, prairie clover, and Drummond's vetch are desirable forbs that decrease during the initial stages of range deterioration.

Blue grama, junegrass, dryland sedge, squirreltail, and wormwood are the most noticeable plants that increase as range condition deteriorates. Common forbs are wild alfalfa, biscuit root, and smallpod vetch. As heavy grazing continues, less common plants, such as buffalograss, Kentucky bluegrass, low rabbitbrush, fringed sage, and three-awn, increase rapidly.

Following prolonged overgrazing, plants that do not grow in the climax vegetation invade the site. Ring muhly, snakeweed, tumblegrass, pricklypear, hairy goldaster, rosinweed, yucca, and annual grasses and weeds are the main invader plants on this site.

Deferring grazing in spring and early in summer favors cool-season grasses, mainly western wheatgrass and green needlegrass, and improves range condition. Because this site is highly susceptible to gully erosion, maintaining western wheatgrass in the plant cover is most important.

The total annual acre yield of vegetation where this site is in excellent condition is 1,200 pounds air-dry weight in favorable years and 600 pounds in less favorable years. Approximately 90 percent of the yield is from plants that furnish forage for domestic livestock.

Cobbly Foothill Range Site

This range site is on the more open slopes in rough broken areas. It consists of well drained and moderately well drained soils having a cobbly clay loam to cobbly loamy sand surface layer derived from rhyolite or granitic material. The subsoil or underlying material is cobbly clay loam to gravelly sandy loam. Slopes are 5 to 50 percent. Annual precipitation is 15 to 19 inches. Permeability is slow to moderate.

Big bluestem, little bluestem, mountain muhly, sandberg bluegrass, and side-oats grama are the most important grasses. They are dominant where this site is in excellent condition. Sandreed is not well adapted. Common forbs are arnica, bluebell, and penstemon.

Blue grama, hairy grama, needle-and-thread, dryland sedge, junegrass, and western wheatgrass are the most prevalent grasses and grasslike plants when the site deteriorates. Less common increaser grasses are squirreltail, three-awn, sand dropseed, and Kentucky bluegrass. Forbs are littlepod vetch, wild alfalfa, yarrow, hairy goldaster, and blazing-star. As heavy grazing continues, mountain-mahogany, snowberry, wild rose, and fringed sagebrush increase.

Following prolonged overgrazing, sandwort, stonecrop, snakeweed, pussytoes, groundsel, and Gambel oak invade the site.

Grazing management should favor maintenance and spread of such decreaser plants as big and little bluestem and mountain muhly.

The total annual acre yield of vegetation where this site is in excellent condition is 1,800 pounds air-dry weight in favorable years and 1,000 pounds in less favorable years. About 90 percent of the yield is from plants that provide forage for livestock and wildlife.

Gravelly Foothill Range Site

This range site consists of well drained and somewhat excessively drained soils that have a gravelly sandy loam to gravelly loamy sand surface layer and a gravelly sandy loam to gravelly clay loam subsoil. Slopes are 8 to 70 percent. Annual precipitation is 15 to 19 inches. Permeability is moderate.

The important grasses in the potential plant community are the needle grasses and prairie sandreed. Junegrass, little bluestem, side-oats grama, the blue grasses, and bluebunch wheatgrass are also common.

Blue grama and western wheatgrass increase as the site deteriorates. Forbs are hairy goldaster, little sunflower, wild alfalfa, blazing-star, and milkvetch. Common shrubs are fringed sagebrush, bush buckwheat, and mountain-mahogany. As heavy grazing continues, less common plants, such as low larkspar, increase rapidly.

Following prolonged overgrazing, Gambel oak, mullein, and snakeweed invade the site.

Deferring grazing late in summer and early in fall improves range condition.

The total annual acre yield of vegetation where this site is in excellent condition is 1,000 pounds air-dry weight in favorable years and 700 pounds in less favorable years. Of this yield, approximately 85 percent is contributed by plants that provide forage for livestock and wildlife.

Loamy Foothill Range Site

This range site is in the northern part of the Area, below an elevation of 6,800 feet. It consists of well-drained soils that have a loam surface layer and a loam to clay subsoil. Slopes are 1 to 25 percent. Annual precipitation is 15 to 19 inches.

The important grasses in the potential plant community are western wheatgrass and, to a lesser extent, green needlegrass. Junegrass and native bluegrasses also grow, but they vary in abundance.

Blue grama increases and becomes sodlike as range condition deteriorates. Wormwood, three-awn, and squirreltail also increase. Fringed sagebrush and dryland sedge occur in small amounts on range in good condition, and they increase under heavy grazing or as adverse weather conditions cause the wheatgrasses and the needlegrasses to decrease. Needle-and-thread grows in some areas but is more suited to sandier soils.

Following prolonged overgrazing, hairy goldaster, pricklypear, snakeweed, curlycup, gumweed, cheatgrass, and other annual grasses and weeds invade the site.

Occasional rest from grazing in spring and early in summer favors cool-season grasses and improves range condition.

The total annual acre yield of vegetation where this site is in excellent condition is 1,400 pounds air-dry weight in favorable years and 800 pounds in less favorable years. About 90 percent of this yield is from plants that produce forage for cattle.

Loamy Park Range Site

This range site consists of well drained and somewhat excessively drained soils that have a loam to gravelly sandy loam and gravelly loamy sand surface layer and a clay loam to gravelly sandy loam and gravelly loamy sand subsoil. Slopes are 1 to 30 percent. Annual precipitation is 15 to 21 inches. Permeability is moderate to rapid.

Mountain bunchgrasses, such as Arizona fescue, mountain muhly, and native bluegrasses, are the most important plants. They are dominant where this site is in excellent condition. Parry oatgrass and little bluestem are also in certain localized areas.

The needlegrasses, junegrass, and western wheatgrass increase as range condition deteriorates.

Following prolonged overgrazing blue grama, slimstem muhly, hairy goldaster, fringed sagebrush, pingue, snakeweed, and various annuals invade the site.

If the bunchgrasses have not been entirely eliminated from the plant composition, deferring grazing throughout the late part of the growing season helps improve range condition.

The total annual acre yield of vegetation where this site is in excellent condition is 1,800 pounds air-dry weight in favorable years and 1,200 pounds in less favorable years. Approximately 90 percent of the yield is from plants that produce forage useful to livestock.

Mountain Meadow Range Site

This range site consists of somewhat poorly drained and moderately well drained soils that have a sandy loam to clay loam surface layer and a clay to sand underlying layer. Slopes are 1 to 5 percent. Annual precipitation is 17 to 21 inches.

Permeability is moderate. The water table is at a depth of less than 5 feet, and in most places the soil is moist below a depth of 12 inches.

Tufted hairgrass, bluejoint reedgrass, slender wheatgrass, and Nebraska sedge are the most prevalent plants.

Many forbs, such as groundsel, water hemlock, arnice, and iris, exist in the plant cover and increase in percentage as range condition deteriorates. Wire rush and ovalhead sedge are also persistent.

Following prolonged overgrazing, yarrow, strawberry weed, foxtail barley, and Kentucky bluegrass invade the site.

This is a good site for the production of native hay. Introducing such plants as smooth brome, timothy, redtop, meadow foxtail, and the clovers improves hay production. Deferring grazing in spring is necessary.

The total annual acre yield of vegetation where this site is in excellent condition is 4,000 pounds air-dry weight in favorable years and 1,600 pounds in less favorable years. Plants that contribute forage for livestock account for about 90 percent of the total yield.

Overflow Range Site

This range site consists of well-drained soils that have a stratified layer of sandy loam to clay loam in the top 20 inches and a loamy sand to clay loam underlying layers. The soils are subject to periodic overflow, which provides additional moisture for plant growth. Slopes are 1 to 5 percent. Annual precipitation is 15 to 19 inches. Permeability is moderate. There is no effective water table.

Western wheatgrass and green needlegrass are dominant where this site is in excellent condition. Spike muhly and slender wheatgrass are less common.

Blue grama, dryland sedge, Kentucky bluegrass, and junegrass increase as range condition deteriorates.

Following prolonged overgrazing, rosinweed, dandelion, fringed sagebrush, snakeweed, and rabbitbrush invade the site.

This site has the potential for producing native hay. Deferring grazing in spring and early in summer improves range condition.

The total annual acre yield of vegetation where this site is in excellent condition is 2,000 pounds air-dry weight in favorable years and 1,200 pounds in less favorable years. Approximately 90 percent of the yield is from plants that furnish forage for cattle.

Rocky Foothill Range Site

This range site consists of well drained and somewhat excessively drained soils that have a cobbly sandy loam to clay loam surface layer. Shale and bedrock are at a depth of 10 to 30 inches. Slopes are 9 to 65 percent. Annual precipitation is 15 to 19 inches. Permeability is moderate to slow.

Big and little bluestem, mountain muhly, spike muhly, sideoats grama, prairie sandreed, and bluebunch wheatgrass are the most important plants. Desirable forbs that decrease during the initial stages of range deterioration are mountain sunflower, spiderwort, and littlepod vetch. Scattered ponderosa pine are also common.

Such shrubs as Gambel oak, mountain-mahogany, wild currant, and squawbrush are the most noticeable plants that increase as range condition deteriorates. Bitterbush occurs in places. Other plants that increase as range condition declines are blue grama, Kentucky bluegrass, needle-and-thread, sandberg

bluegrass, squirreltail, three-awn, dryland sedge, fringed sagebrush, hairy goldaster, and wormwood.

Following prolonged overgrazing, sleepygrass, Russian knapweed, snakeweed, and such annuals as cheatgrass, kochia, lambsquarters, and wild mustard invade this site.

Deferring grazing in summer and early in fall favors big and little bluestem, side-oats grama, and mountain muhly and improves range condition.

The total annual acre yield of vegetation where this site is in excellent condition is 1,600 pounds air-dry weight in favorable years and 800 pounds in less favorable years. Approximately 70 percent is for plants that provide forage for domestic livestock and big game.

Sandy Divide Range Site

This range site consists of well drained to excessively drained soils that have a sandy loam and loamy sand surface layer and a sandy clay loam to sand subsoil and underlying layer. Slopes are 1 to 25 percent. Annual precipitation is 17 to 21 inches. Permeability is slow to rapid.

The natural vegetation on this site consists of grasses and other plants from the prairies as well as from the mountains. Big bluestem, little bluestem, prairie sandreed, mountain muhly, and prairie dropseed are the most important. Fringed sagebrush, wormwood, and buckwheat bush are present in small amounts.

Blue grama, needle-and-thread, junegrass, squirreltail, three-awn, western wheatgrass, and sandberg bluegrass are the most noticeable plants that increase as range condition deteriorates.

Following prolonged overgrazing, Gambel oak, sleepygrass, pricklypear, hairy goldaster, mullein, and annuals invade this site.

Deferring grazing in summer is necessary for maintaining desirable grasses.

The total annual acre yield of vegetation where this site is in excellent condition is 2,000 pounds air-dry weight in favorable years and 900 pounds in less favorable years. Approximately 90 percent of the yield is from plants that furnish forage for livestock.

Sandy Foothill Range Site

This range site consists of well drained and somewhat excessively drained soils that have a sandy loam surface layer and a clay loam to loamy sand subsoil. Slopes are 1 to 20 percent. Annual precipitation is 15 to 19 inches. Permeability is rapid.

Big bluestem, little bluestem, and prairie sandreed are the most important plants. They are dominant where this site is in excellent condition. Thickspike wheatgrass also occurs.

Needle-and-thread, blue grama, sand dropseed, junegrass, three-awn, and dryland sedge increase as range condition deteriorates. Common forbs that increase as range condition deteriorates are gayfeather, penstemon, wild alfalfa, globemallow, lupine, and hairy goldaster. Shrubs and half-shrubs such as squawbush, mountain-mahogany, snowberry, currant, yucca, fringed sage, wormwood, and buckwheat bush are also present.

Following prolonged overgrazing, Gambel oak invades the site. Mullein, snakeweed, pricklypear, and annuals are also present.

Deferring grazing late in summer and fall help maintain the desirable grasses.

The total annual acre yield of vegetation where this site is in excellent condition is 1,500 pounds air-dry weight in favorable years and 800 pounds in less favorable years. About 80 percent of the yield is from plants that produce forage useful to livestock or big game.

Shallow Foothill Range Site

This range site consists of well drained and somewhat excessively drained soils that have a gravelly loam to loamy sand surface layer and a gravelly loam subsoil. Slopes are 10 to 50 percent. Annual precipitation is 15 to 19 inches. Permeability is rapid.

Blue grama, sandberg bluegrass, dryland sedge, and fringed sagebrush are the most noticeable plants that increase as range condition deteriorates.

Following prolonged overgrazing, sagebrush, sand dogweed, forbs, and annuals invade the site.

Deferring grazing in summer favors grasses, mainly big bluestem, little bluestem, and side-oats grama, and improves range condition.

Such browse plants as mountain-mahogany, are the dominant vegetative cover on this site. Juniper and ponderosa pine are also present. Big bluestem, little bluestem, and the needle grasses are important plants.

The total annual acre yield of vegetation where this site is in excellent condition is 500 pounds air-dry weight in favorable years and 300 pounds in less favorable years. About 60 percent of the yield is from plants that provide forage for domestic livestock. An additional 20 percent is made up of plants useful as forage and cover for big game animals.

Stony Loam Range Site

This range site consists of well drained and somewhat excessively drained soils that have a surface layer and underlying layer of cobbly, flaggy, and gravelly sandy loam and loam. Slopes are 9 to 65 percent. Annual precipitation is 17 to 21 inches. Permeability is slow to rapid.

Brush with scattered ponderosa pine or juniper is the dominant vegetative cover on this site. The dominant grasses are mountain muhly, big and little bluestem, and needle-and-thread. Arizona fescue, mountain brome, timber oatgrass, and bluebunch wheatgrass also grow but are difficult to maintain in the plant cover. Desirable forbs during initial stages of range deterioration are Drummond's vetch, arnica, goldeneye, and blazing-star.

Such browse plants as Gambel oak, mountain-mahogany, wild currant, and snowberry, are the most noticeable plants that increase as range condition deteriorates. Common grasses and grasslike plants that increase as range condition deteriorates are junegrass, blue grama, western wheatgrass, squirreltail, three-awn, and dryland sedge. Forbs that increase as range condition deteriorates are strawberry weed (cinquefoil), yarrow, golden banner, and goldenrod. Fringed sagebrush and wormwood are half-shrubs that increase.

Following prolonged overgrazing, hairy goldaster, sleepygrass, Kentucky bluegrass, and mullein invade the site.

Deferring grazing in summer and early fall favor grasses, mainly big and little bluestem, mountain muhly, and needle-and-thread, and improves range condition.

The total annual acre yield of vegetation where this site is in excellent condition is 1,200 pounds air-dry weight in favorable years and 800 pounds in less favorable years. Approximately 80 percent of the yield is from plants that furnish forage for livestock and deer.

Woodland[5/]

About 8 percent of the Castle Rock Area is in native tree cover, but there is very limited harvest of wood products. The harvest is primarily for posts, poles, firewood, and occasionally for railroad ties.

The native tree cover is mainly second growth Ponderosa pine and Gambel oak. There is a scattering of Douglas-fir, white fir, blue spruce, and aspen on some of the cooler, more moist, north-facing slopes.

These wooded areas are on soils of the Falcon, Juget, Kettle, Larkson, Plome, and Stapleton series. Borings and measurements of trees indicate that it takes about 160 years to grow a 14-inch diameter Ponderosa pine on the Kettle, Larkson, and Plome soils and even longer on the Falcon, Juget, and Stapleton soils. This slow growth results in the wooded areas being of more value for homesites, recreation, woodland grazing, watershed protection, and wildlife than for wood production.

Gambel oak has spread out from the native tree-covered areas, and it is the dominant plant on many areas of Crowfoot, Redridge, Redtom, Tomah, and Westcreek soils, as well as on the land types of Rockland, Shale outcrop, Stony rough land, Stony steep land, and Stony steep land, cold. Minor amounts of Gambel oak have also invaded areas of Cheeseman, Gove, Jarre, Kutch, Newlin, Peyton, Pring, and Tinytown soils. These areas of Gambel oak have an understory of grass and are used primarily for grazing.

Trees for shade and landscaping will grow on nearly all the soils of the Area if they are cultivated or watered. Ponderosa pine, Rocky Mountain juniper, hackberry, American plum, Chinese (Siberian) elm, and Russian-olive are best adapted to the soils of the Area. Blue spruce, green ash, honeylocust, cottonwood, and willow are also suitable if they are irrigated or watered.

Recreation[6/]

The rapid urbanization of Castle Rock Area is causing major changes in land use, and with these changes, a major shift in the use of the land for recreation. The present expansion of urban developments into areas that were formerly rural greatly limits recreational activities, such as hunting, that require large areas of open space and suitable habitat for wildlife species. On the other hand, forms of recreation associated with and developed in or near urban areas, such as vacation farms, dude ranches, picnic areas, and sports areas, are not so limited.

The limitations of the soils for recreational development are shown in table 3, by soil associations. Characteristics considered in evaluating the soil associations are wetness, slope, flooding, depth, high water table, texture, acidity, and stoniness.

A rating of slight indicates that the soil has few limitations and that they are easily overcome. A soil rated moderate has limitations that can be overcome, but these require special measures or treatments. A rating of severe indicates limitations so serious that extensive measures or treatments are required. This rating does not imply that the soil in a given association cannot be used for the purpose stated. Where the rating is severe, however, the cost involved in overcoming the limitation may not be justified.

The broad classification by soil associations should be noted. The ratings given in the table do not eliminate the need for investigations at the site.

Specific soil interpretations of suitability of soils for such things as septic tank and leach field development, fish ponds, roads and trails, and foundation construction are in tables 7 and 8. The section "Engineering Uses of Soils" contains some detailed information needed for engineering design.

Wildlife[6/]

Use of the land has greatly affected the number of wildlife in the Castle Rock Area. Great land use changes have occurred in the past, and more changes are now occurring at an accelarated rate. Much of the present change in land use is from agricultural uses to uses associated with urbanization. The soil associations most likely to receive the brunt of the urbanization process are those that lie adjacent to and on both sides of U.S. Interstate 25, although,

5/ By W. S. SWENSON, woodland conservationist, Soil Conservation Service.

6/ ELDIE W. MUSTARD, biologist, Soil Conservation prepared this section and the section on Wildlife.

TABLE 3.--LIMITATIONS OF SOIL ASSOCIATIONS

Soil association	Degree of limitation for--			
	Vacation farms and dude ranches	Picnic and sports areas	Fishing	
			Natural	Developed
1. Loamy alluvial land-Sampson.	Severe	Moderate	Severe	Severe
2. Fondis-Kutch	Severe	Severe	Severe	Severe
3. Bresser-Newlin-Stapleton.	Moderate	Moderate	Severe	Severe
4. Razor-Denver	Severe	Severe	Severe	Severe
5. Peyton-Kettle-Crowfoot.	Moderate	Moderate	Severe	Moderate
6. Brussett-Jarre	Moderate	Moderate	Severe	Moderate
7. Garber-Kassler-Rockland.	Slight	Slight	Moderate	Severe
8. Juget-Rock land	Moderate	Moderate	Moderate	Severe

Degree of limitation for--Continued					
Campsites, scenic areas, and nature areas	Hunting areas			Shooting preserves	Sites for rural cottages, camps and homesites
	Big game	Upland game	Waterfowl		
Moderate	Severe	Moderate	Severe	Slight	Severe.
Severe	Severe	Moderate	Severe	Moderate	Moderate.
Moderate	Moderate	Moderate	Severe	Severe	Slight.
Severe	Severe	Severe	Severe	Severe	Severe.
Slight	Moderate	Moderate	Severe	Severe	Moderate.
Moderate	Severe	Moderate	Severe	Moderate	Slight.
Slight	Moderate	Moderate	Severe	Severe	Moderate.
Slight	Slight	Moderate	Severe	Severe	Severe.

TABLE 4.--SUITABILITY OF SOIL

Soil association	Wildlife and fish	Suitability for--
		Food
1. Loamy alluvial land-Sampson	Mule deer	Moderately well suited
	Cottontail	Well suited
	Mourning dove	Well suited
	Pheasant	Poorly suited
	Bobwhite	Moderately well suited
	Waterfowl	Poorly suited
	Fish	Not applicable
2. Fondis-Kutch	Mule deer	Poorly suited
	Antelope	Moderately well suited
	Cottontail	Well suited
	Jackrabbit	Moderately well suited
	Mourning dove	Moderately well suited
	Pheasant	Moderately well suited
	Sharp-tailed grouse	Well suited
3. Bresser-Newlin-Stapleton	Mule deer	Well suited
	Bear	Moderately well suited
	Cottontail	Well suited
	Mourning dove	Moderately well suited
	Sharp-tailed grouse	Well suited
	Fish	Not applicable
4. Razor-Denver	Mule deer	Poorly suited
	Antelope	Moderately well suited
	Cottontail	Poorly suited
	Jackrabbit	Moderately well suited
	Mourning dove	Poorly suited
5. Peyton-Kettle-Crowfoot	Mule deer	Poorly suited
	Antelope	Moderately well suited
	Bear	Moderately well suited
	Cottontail	Moderately well suited
	Jackrabbit	Moderately well suited
	Mourning dove	Moderately well suited
	Sharp-tailed grouse	Well suited
	Fish	Not applicable
6. Brussett-Jarre	Mule deer	Poorly suited
	Antelope	Moderately well suited
	Cottontail	Moderately well suited
	Jackrabbit	Moderately well suited
	Mourning dove	Moderately well suited
	Sharp-tailed grouse	Moderately well suited
	Fish	Not applicable
7. Garber-Kassler-Rockland	Mule deer	Well suited
	Bear	Moderately well suited
	Cottontail	Well suited
	Mourning dove	Moderately well suited
	Sharp-tailed grouse	Well suited
	Turkey	Well suited
	Fish	Not applicable
8. Juget-Rock land	Mule deer	Well suited
	Bear	Well suited
	Cottontail	Well suited
	Turkey	Well suited
	Bluegrouse	Well suited
	Fish	Not applicable

Suitability for--Continued		
Cover	Aquatic environment	
	Natural	Developed
Moderately well suited	Poorly suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Well suited	Poorly suited	Poorly suited.
Moderately well suited	Not applicable	Not applicable.
Moderately well suited	Not applicable	Not applicable.
Poorly suited	Poorly suited	Poorly suited.
Not applicable	Poorly suited	Poorly suited.
Poorly suited	Poorly suited	Poorly suited.
Not applicable	Poorly suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Moderately well suited	Not applicable	Not applicable.
Well suited	Poorly suited	Poorly suited.
Poorly suited	Not applicable	Not applicable.
Moderately well suited	Not applicable	Not applicable.
Well suited	Poorly suited	Poorly suited.
Well suited	Poorly suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Well suited	Poorly suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Not applicable	Poorly suited	Poorly suited.
Poorly suited	Poorly suited	Well suited.
Not applicable	Poorly suited	Well suited.
Poorly suited	Not applicable	Not applicable.
Not applicable	Not applicable	Not applicable.
Poorly suited	Poorly suited	Well suited.
Moderately well suited	Poorly suited	Moderately well suited.
Not applicable	Poorly suited	Moderately well suited.
Moderately well suited	Poorly suited	Moderately well suited.
Moderately well suited	Not applicable	Not applicable.
Not applicable	Not applicable	Not applicable.
Moderately well suited	Poorly suited	Moderately well suited.
Well suited	Not applicable	Not applicable.
Not applicable	Poorly suited	Moderately well suited.
Poorly suited	Poorly suited	Moderately well suited.
Not applicable	Poorly suited	Moderately well suited.
Moderately well suited	Not applicable	Not applicable.
Not applicable	Not applicable	Not applicable.
Moderately well suited	Poorly suited	Moderately well suited.
Moderately well suited	Not applicable	Not applicable.
Not applicable	Poorly suited	Moderately well suited.
Well suited	Moderately well suited	Poorly suited.
Well suited	Moderately well suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Well suited	Moderately well suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Well suited	Moderately well suited	Poorly suited.
Not applicable	Moderately well suited	Poorly suited.
Well suited	Moderately well suited	Poorly suited.
Well suited	Moderately well suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Well suited	Moderately well suited	Poorly suited.
Well suited	Not applicable	Not applicable.
Not applicable	Moderately well suited	Poorly suited.

rural homesites will cause changes in land uses in other areas as the human population spreads eastward from the urban strip.

Generally, urban land uses are not beneficial to many species of wildlife. For example, mule deer, turkey, black bear, and sharp-tailed grouse now inhabit some areas in the survey area, but as the land is put to urban use, the natural food, cover, and water for these wildlife species will disappear.

Table 4 shows the suitability of each of the eight soil associations for the elements of habitat for specified kinds of wildlife. Ratings are based on the ability of the soils of the association to provide food, cover, and water. For descriptions of the soil associations, see the section "General Soil Map."

Presently wildlife primarily serves a beneficial use by providing recreation to either those people who hunt and fish or to those who enjoy wildlife for purely esthetic reasons. Opportunities for wildlife developments, such as shooting preserves and fee-fishing ponds, will become greater as the population expands and demands for these types of activities increase.

The Loamy alluvial land-Sampson association, the Fondis-Kutch association, and the Brussett-Jarre association offer potential for shooting preserves. These associations have potential to provide the cover needed for operating a shooting preserve.

The potential for fish ponds is not so great as the potential for shooting preserves because of limitations such as lack of water. Adequate sites for fee-fishing ponds may be found, however, on the Peyton-Kettle-Crowfoot association, the Brussett-Jarre association, the Garber-Kassler-Rockland association, and the Juget-Rock land association. Where the quality of water is suitable, trout can be stocked for put-and-take fishing. Some ponds are suitable for warm-water species.

Assistance for planning wildlife developments can be obtained through the local Soil Conservation Service and from the Colorado Division of Game, Fish, and Parks.

Engineering Uses of the Soils[7/]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the properties most important to engineers are permeability, strength, consolidation characteristics, texture, plasticity, and soil reaction. Depth to unconsolidated materials and topography are also important.

Information concerning these and related soil properties is given in tables 5, 6, and 7. The estimates and interpretations in these tables can be used to--

1. Make studies that will aid in selecting and developing industrial, commercial, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning drainage systems, farm ponds, irrigation systems, terraces, waterways, and diversion terraces.
3. Make preliminary evaluations of soil conditions that will aid in selecting sites for highways, airports, pipelines, and cables and in planning detailed investigations at selected locations.
4. Locate probable sources of gravel, sand, and other construction material.
5. Correlate performance of soil mapping units to develop information that will be useful in planning engineering practices and in designing and maintaining engineering structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement other publications, such as maps, reports, and aerial photographs, that are used in preparation of engineering reports for a specific area.
8. Develop other perliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths reported (ordinarily about 5 feet). Even in these situations, however, the soil map is useful in planning more detailed field investigations and in indicating the kinds of problems that may be expected.

Some of the terms used by soil scientists have special meanings in soil science that may not be familiar to engineers. These terms are defined in the Glossary.

Engineering Classification

The two systems most commonly used in classifying soils for engineering are the systems approved by the American Association of State Highway Officials (AASHO) and the Unified system.

The AASHO system (1) is used to classify soils according to those properties that affect use in highway construction. In this system all soil material is classified in seven principal groups. The groups range from A-1, which consists of soils that have the highest bearing strength and are the best soils for subgrade, to A-7, which consists of soils that have the lowest strength when wet. Within each group, the relative engineering value of the soil material is indicated by a group index number. The numbers range from 0, for the best material, to 20, for the poorest. The group index number is shown in parentheses following the soil group system (table 5).

7/ MILLARD F. DILSAVER, civil engineer, Soil Conservation Service, helped prepare this section.

In the Unified system (7) soils are classified according to their texture and plasticity and their performance as engineering construction material. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. GP and GW are clean gravels, and GM and GC are gravels that include, respectively, an appreciable amount of nonplastic and plastic fines. SP and SW are clean sands. SM and SC are sands that include fines of silt and clay. ML and CL are silts and clays that have a low liquid limit, and MH and CH are silts and clays that have a high liquid limit. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

Soil scientists use the USDA textural classification (6). In this, the texture of the soil is determined according to the proportion of soil particles smaller than 2 millimeters in diameter, that is, the porportion of sand, silt, and clay. Textural modifiers, such as gravelly, stony, shaly, and cobbly, are used as needed.

Table 5 shows the AASHO and Unified classification of specified soils in the Area, as determined by laboratory tests. Table 6 shows the estimated classification of all the soils in the Area according to all three systems of classification, and table 7 gives the suitability of soil material for certain construction uses.

Engineering Test Data

Table 5 shows engineering test data for samples of 10 different soils taken within the survey area. These soils were tested by the Colorado Department of Highways in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

The soils shown in this table were sampled in one or more locations, but the test data given in any one location indicate the engineering characteristics of the soil at that specific location. Physical characteristics of this soil can vary from place to place in the survey area, and therefore the test data probably do not show the maximum range in characteristics of materials that may occur. The results of the tests are reported in customary engineering terms, some of which are explained below.

Moisture density data are obtained by compacting soil material at successively higher moisture content. Assuming that the compactive effect remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed maximum dry density. Data showing moisture density are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted at about the maximum dry density when it is at approximately the optimum moisture content.

In table 5 specific gravity refers to the ratio of the weight of the soil material to the weight of pure water.

The engineering soil classifications are based upon data obtained by mechanical analysis and by tests to determine liquid limit and plasticity index. The mechanical analysis was made by combined use of sieve and hydrometer methods.

Tests for liquid limit and plastic limit measure the effect of water on the consistency of soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to semisolid or plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates a range of moisture content within which a soil material is plastic. Some silty and sandy soils are nonplastic, that is, they will not become plastic at any moisture content.

Estimated Properties of the Soils

Table 6 gives the estimated properties of all the soils in the Castle Rock Area. In most of the soils in the Area the water table is at such a great depth that it is not significant to engineering. However, the water table is at a depth of less than 5 feet in Loamy wet alluvial land, at a depth of more than 3 feet in Peyton sandy loam, wet, and at a depth of 3 to 5 feet in Sandy wet alluvial land.

The estimated range in percentage passing sieves Nos. 4, 10, 40 and 200 reflects the normal range for a given soil. Most soils fall within the range given. However, the texture (grain size) of any soil varies considerably, especially that of alluvial (water-deposited) materials. It should therefore not be assumed that all samples of a given soil will fall within the range shown, nor that the engineering classification will always be the same as shown.

Permeability of a soil is its ability to transmit water and air. As used in this report, it is the "in place" permeability and is estimated from soil texture, structure, and porosity and is compared with permeability tests on undisturbed cores of similar soil material. Permeability is shown as a class in which the soil normally will fall. These classes are as follows: slow, less than 0.06 to 0.2 inches per hour; moderate, 0.63 to 2.0 inches per hour; and rapid, 6.3 to 20.0 inches per hour.

Available water capacity gives the approximate amount of water held in the soil in a form plants can readily use. It is an estimate of the water that the soil holds between field capacity and the wilting point.

TABLE 5.--ENGINEERING

Tests performed by the Colorado Department of Highways in accordance with standard

Soil name and location	Parent material	SCS report number S-63-Colo-18	Depth from surface of typical profile	Moisture-density data 1/		Specific gravity	Mechanical analysis 2/	
				Maximum dry density	Optimum moisture		Percentage passing sieve--	
							3/4 inch	3/8 inch
			Inches	Lb./cu. ft.	Pct.			
Brussett loam:								
1,200 feet west and 600 feet north of SE. corner of section 21, T. 10 S., R. 65 W.	Eolian silts and sands.	7-4	13-19	103	20	2.64	---	---
		7-8	51-69	114	15	2.63	---	---
Crowfoot sandy loam:								
1,320 feet west and 85 feet north of SE. corner of NE¼ of section 28, T. 10 S., R. 66 W.	Dawson arkose-----	9-5	19-24	109	15	2.60	100	99
		9-7	32-43	110	14	2.57	---	100
Fondis clay loam:								
122 feet west of SE. corner of section 19, T. 8 S., R. 66 W.	Outwash and eolian.	4-4	12-24	101	22	2.67	---	---
		4-6	28-45	100	22	2.65	---	---
		4-8	57-70	97	24	2.67	---	---
Kettle loamy sand:								
550 feet west and 150 feet north of SE. corner of section 34, T. 10 S., R. 66 W.	Dawson arkose-----	2-5	26-36	123	10	2.56	99	96
		2-6	36-60	122	10	2.57	100	99
Larkson fine sandy loam:								
1,900 feet east and 200 feet north of SW. corner of section 14, T. 9 S., R. 67 W.	Outwash and eolian eolian.	10-6	33-44	106	18	2.63	---	100
Perrypark sandy loam:								
255 feet east and 2,340 feet north of SW. corner of section 31, T. 9 S., R. 67 W.	Eolian material---	11-4	18-45	120	11	2.59	---	---
Peyton sandy loam:								
1,200 feet east and 400 feet south of NW. corner of section 21, T. 10 S., R. 66 W.	Dawson arkose-----	5-2	7-15	116	13	2.58	---	---
		5-5	24-34	119	12	2.60	---	100
		5-8	48-76	109	15	2.59	---	100

TEST DATA

procedures of the American Association of State Highway Officials (AASHO) (1/)

Mechanical analysis 2/--Continued					Liquid limit	Plasticity index	Classification	
Percentage passing sieve--Continued				Percentage smaller than--			AASHO	Unified
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.02 mm.				
					Pct.			
---	100	98	85	50	42	21	A-7-6(13)	CL
---	100	89	62	38	30	13	A-6(7)	CL
95	73	46	29	22	51	28	A-2-7(3)	SC
96	71	30	16	11	46	22	A-2-7(0)	SC
---	100	99	89	61	52	30	A-7-6(18)	CH
100	97	90	78	(3/)	51	29	A-7-6(18)	CH
100	98	91	80	(3/)	51	27	A-7-6(17)	CH
89	68	41	18	13	26	6	A-1-b(0)	SM-SC
92	70	34	13	10	24	2	A-1-b(0)	SM
99	94	74	54	41	49	25	A-7-6(11)	CL
100	97	70	28	21	24	6	A-2-4(0)	SM-SC
100	97	73	32	19	26	7	A-2-4(0)	SM-SC
99	96	67	38	26	34	16	A-6(2)	SC
99	94	25	7	--	(4/)	(4/)	A-1-b(0)	SM-SP

Soil name and location	Parent material	SCS report number S-63-Colo-18	Depth from surface of typical profile	Moisture-density data 1/		Specific gravity	Mechanical analysis 2/	
				Maximum dry density	Optimum moisture		Percentage passing sieve--	
							3/4 inch	3/8 inch
			Inches	Lb./cu. ft.	Pct.			
Plome loamy sand: 250 feet east and 300 feet south of NW. corner of section 26, T. 9 S., R. 68 W.	Fountain outwash-	14-4	17-30	122	9	2.58	---	100
Razor clay: 2,490 feet east and 600 feet north of SW. corner of section 10, T. 9 S., R. 68 W.	Pierre shale------	12-4	14-27	95	24	2.76	---	---
Satanta loam, calcareous variant: 1,500 feet west and 2,340 feet south of NE. corner of section 14, T. 9 S., R. 68 W.	Niobara outwash material.	13-4	22-31	103	20	2.68	---	100

1/ Based on AASHO Designation: T 99-57, Method A (1/).

2/ Mechanical analysis according to AASHO Designation: T 88-57 (1/). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

TEST DATA--Continued

Mechanical analysis 2/--Continued					Liquid limit	Plasticity index	Classification	
Percentage passing sieve--Continued				Percentage smaller than--			AASHO	Unified
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.02 mm.				
					Pct.			
99	87	46	15	10	(4/)	(4/)	A-1-b(0)	SM
---	100	99	97	94	71	44	A-7-6(20)	CH
99	97	94	80	65	45	24	A-7-6(15)	CL

3/ Hydrometer analysis could not be performed because the soil material contained lime.

4/ Nonplastic.

TABLE 6.--ESTIMATED SOIL PROPERTIES

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or this reason it is necessary to follow carefully the instructions for referring to

Soil series and map symbols	Hydrologic soil group	Depth to bedrock	Depth from surface	Classification		
				Dominant USDA texture	Unified	AASHO
		Inches	Inches			
*Blakeland: BlE, Bo------- For Orsa part of Bo, see Orsa series.	A	>60	0-60	Loamy coarse sand and sand.	SM or SP-SM	A-3
*Bresser: BrB, BrD, BsE, BtE, BuD2. For Louviers part of BsE, see Louviers series; for Truckton parts of BtE and BuD2, see Truckton series.	B	>60	0-8 8-30 30-60	Sandy loam---------- Sandy clay loam---------- Sandy loam or loamy sand-	SM SC or CL SM	A2 A-4 or A-6 A-2
Brussett: BvB, BvD--------	B	>60	0-26 26-60	Clay loam---------- Loam----------	CL CL	A-6 A-6
*Buick: BwD---------- For Satanta part of BwD, see Satanta series.	C	>60	0-22 22-60	Silty clay loam---------- Sandy clay loam or clay loam.	CL SC or CL	A-6 A-4, A-6
Chaseville---------- Mapped only with Redridge soils.	A	>60	0-60	Very gravelly loamy sand-	SP	A-1
Cheeseman---------- Mapped only with Tinytown soils.	B	20-40	0-31 31	Clay loam---------- Shale and sandstone.	SC	A-6
Coni: CoG----------	D	10-20	0-17	Clay loam----------	CL	A-6
*Crowfoot: CrE---------- For Tomah part of CrE, see Tomah series.	B	>60	0-19 19-43 43-60	Loamy sand---------- Sandy clay loam---------- Coarse sand----------	SM SC SC or SP-SM	A-2 A-2 A-1
*Cruckton: CsD, CtE------- For Peyton part of CtE, see Peyton series.	B	>60	0-60	Sandy loam----------	SM or SC	A-2 or A-4
Denver: DeD----------	C	>40	0-55	Clay or clay loam--------	CH or CL	A-7
Englewood: En----------	C	>60	0-60	Clay----------	CH or CL	A-6 or A-7
Falcon---------- Mapped only with Kettle soils.	D	4-20	0-14	Gravelly sandy loam------	SM	A-2

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for other series that appear in the first column of this table. Symbol means more than]

Percentage less than 3 inches in diameter passing sieve--				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
				Inches per hour	Inches per inch of soil	pH	Millimhos per cm.	
100	100	50-75	5-25	6.3-20.0	0.05-0.07	6.1-7.8	0-2	Low.
100	100	60-70	20-40	2.0-6.3	0.11-0.13	6.1-7.8	0-2	Low.
100	100	80-90	35-55	0.63-2.0	0.14-0.16	6.1-7.8	0-2	Moderate.
100	90-100	50-70	15-35	2.0-6.3	0.06-0.13	6.1-7.8	2-4	Low.
100	100	90-100	70-85	0.63-2.0	0.19-0.21	6.1-7.8	0-2	Moderate.
100	100	85-95	60-85	0.63-2.0	0.16-0.18	7.0-8.5	0-2	Moderate.
100	100	95-100	85-95	0.63-2.0	0.19-0.21	6.6-7.8	0-2	Moderate.
100	80-100	75-90	35-70	0.63-2.0	0.14-0.21	7.3-9.0	2-4	Moderate.
70-80	10-50	10-25	0-5	6.3-20.0	0.04-0.08	6.1-7.8	0-2	Low.
90-95	60-80	50-70	35-50	0.63-2.0	0.17-0.19	6.1-7.3	0-2	Moderate.
95-100	90-95	80-90	60-75	0.63-2.0	0.19-0.21	5.6-7.8	0-2	Moderate.
95-100	80-100	40-75	15-30	6.3-20.0	0.06-0.08	5.6-7.3	0-2	Low.
90-100	70-100	60-80	25-50	0.63-2.0	0.14-0.16	5.6-7.8	0-2	Moderate.
90-100	70-100	30-50	0-15	6.3-20.0	0.05-0.07	5.6-7.8	0-2	Low.
100	100	60-70	20-40	2.0-6.3	0.11-0.13	6.1-7.8	0-2	Low.
100	100	90-100	75-95	0.06-0.20	0.14-0.17	6.1-9.0	2-4	High.
100	100	90-100	75-95	0.06-0.20	0.14-0.16	6.6-9.0	2-4	High.
60-95	50-85	30-50	15-30	2.0-6.3	0.11-0.13	6.1-7.8	0-2	Low.

Soil series and map symbols	Hydrologic soil group	Depth to bedrock	Depth from surface	Classification		
				Dominant USDA texture	Unified	AASHO
		Inches	Inches			
*Fondis: FoB, FoD, Fu----	C	>60	0-24	Clay----------	CH	A-7
			24-60	Sandy clay loam----------	SC	A-7
For Kutch part of Fu, see Kutch series.						
Garber: GaE----------	A	>60	0-60	Very gravelly sandy loam.	SP-SM	A-1
Gove: GoE, GsF----------	B	>60	0-28	Sandy loam or loamy sand-	SM	A-2
			28-56	Sandy clay loam----------	SC	A-4
			56-60	Gravelly sandy loam------	SM	A-2
The properties of the shale outcrop part of GsF are too variable to be estimated.						
Heldt: He----------	C	>60	0-60	Clay----------	CH	A-7
Hilly gravelly land: Hg----	D	20-40	0-20	Cobbly sandy loam to cobbly clay loam.	(1/)	(1/)
			20	Shale.		
*Jarre: Jb----------	B	>60	0-26	Loam to gravelly clay loam.	SC or CL	A-1
			26-60	Very gravelly loamy sand-	SP-SM	A-1
For Brussett part of Jb, see Brussett series.						
Juget: JuF, JvF----------	D	10-20	0-15	Gravelly loamy sand------	GP-GM	A-1
			15	Granite.		
Kassler: Ka----------	A	>60	0-60	Very gravelly loamy sand-	SP-SM	A-1
*Kettle: KeE, KfF----------	B	>60	0-26	Loamy sand----------	SM	A-1
			26-36	Sandy loam----------	SM or SC	A-1 or A-2
			36-60	Loamy coarse sand--------	SP-SM	A-1
For Falcon part of KfF, see Falcon series.						
*Kippen: KnE, KpD2----------	A	>60	0-32	Loamy sand----------	SM	A-2
			32-60	Fine sand----------	SP-SM	A-2
For Pring part of KpD2, see Pring series.						
*Kutch: KtE, KuD, KuE, KwF.	D	20-40	0-32	Clay or clay loam--------	CL or CH	A-6 or A-7
For Newlin part of KwF, see Newlin series; for Stapleton part of KwF, see Stapleton series.						
Larkson: LaD----------	C	>40	0-13	Fine sandy loam and loam-	ML	A-4
			13-54	Clay and clay loam-------	CL or CH	A-7

SIGNIFICANT IN ENGINEERING--Continued

Percentage less than 3 inches in diameter passing sieve--				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
				Inches per hour	Inches per inch of soil	pH	Millimhos per cm.	
100	85-95	75-90	60-95	0.06-0.20	0.14-0.16	6.1-7.8	0-2	High.
100	80-90	60-75	35-50	0.20-0.63	0.19-0.21	7.3-9.0	2-8	Moderate.
70-90	20-40	15-30	5-12	6.3-20.0	0.07-0.09	5.6-7.3	0-2	Low.
95-100	90-100	50-70	15-30	2.0-6.3	0.06-0.13	5.6-7.3	0-2	Low.
90-100	90-100	70-90	35-50	0.63-2.0	0.14-0.16	5.6-7.3	0-2	Moderate.
90-100	45-75	40-60	15-30	2.0-6.3	0.7-0.11	5.6-7.3	0-2	Low.
100	100	90-100	75-95	0.06-0.20	0.14-0.16	7.4-9.0	4-8	High.
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95-100	60-85	40-70	35-60	0.63-2.0	0.16-0.21	6.1-7.8	0-2	Low.
85-95	20-40	10-30	5-10	6.3-20.0	0.03-0.08	6.1-7.8	0-2	Low.
20-45	20-40	10-35	5-12	6.3-20.0	0.05-0.08	5.1-7.3	0-2	Low.
70-80	20-40	10-30	5-10	6.3-20.0	0.05-0.08	6.1-7.8	0-2	Low.
90-100	75-100	40-70	12-30	6.3-20.0	0.06-0.08	5.1-6.5	0-2	Low.
85-100	65-95	40-60	20-35	2.0-6.3	0.11-0.13	5.1-6.5	0-2	Low.
85-95	60-80	30-40	5-12	6.3-20.0	0.05-0.08	5.1-6.5	0-2	Low.
100	95-100	50-75	15-30	6.3-20.0	0.06-0.08	5.6-7.3	0-2	Low.
100	95-100	50-70	5-12	6.3-20.0	0.05-0.07	5.6-7.3	0-2	Low.
100	95-100	85-100	70-95	0.06-0.20	0.14-0.16	6.1-8.4	2-4	Moderate to high.
100	95-100	60-80	55-75	0.63-2.0	0.16-0.18	5.6-7.3	0-2	Low.
95-100	90-100	85-95	70-90	0.06-0.20	0.14-0.21	6.1-7.8	0-2	High.

Soil series and map symbols	Hydrologic soil group	Depth to bedrock	Depth from surface	Classification		
				Dominant USDA texture	Unified	AASHO
		Inches	Inches			
Loamy alluvial land: Lo---	C	>60	0-20	Sandy loam to clay loam--	SM, CL, or ML	A-2, A-4, or A-6
			20-60	Loamy sand to clay loam--	SM, CL, or ML	A-2, A-4, or A-6
Loamy alluvial land, dark surface: Lu.	C	>60	0-40	Sandy loam to clay loam--	ML or CL	A-4 or A-6
Loamy wet alluvial land: Lw.	D	>60	0-20	Sandy loam to clay loam--	SM, CL, or ML	A-2, A-4, or A-6
			20-60	Loamy sand to clay-------	SM, CL, or ML	A-2, A-4, or A-6
Lonetree---------- Mapped only with Rockland.	A	>40	0-60	Loamy sand or sand-------	SP-SM or SM	A-2
Louviers---------- Mapped only with Bresser series.	D	10-20	0-12	Clay----------	CL or CH	A-6 or A-7
			12	Shale.		
Manzanola: Ma----------	C	>40	0-60	Clay loam----------	CL or CH	A-6 or A-7
*Newlin: NeE, NsE--------- For Satanta part of NsE, see Satanta series.	B	>60	0-22	Gravelly sandy loam------	SM or GM	A-1 or A-2
			22-60	Very gravelly sand-------	GP or SP	A-1
Orsa---------- Mapped only with Blakeland soils.	A	>60	0-60	Coarse sandy loam and gravelly loamy sand.	SM or SP-SM	A-1
Perrypark: PdE----------	B	>60	0-12	Sandy loam----------	SM	A-2
			12-36	Sandy clay loam----------	SC or CL	A-4
			36-60	Sandy loam----------	SM	A-2
*Peyton: PeB, PeD, PfC, PpE, PrE2. For Pring parts of PpE and PrE2, see Pring series; for Crowfoot parts of PpE and PrE2, see Crowfoot series.	B	>60	0-11	Sandy loam----------	SM	A-2
			11-30	Sandy clay loam----------	SC or CL	A-4 or A-6
			30-60	Sandy loam----------	SM	A-2
Plome: PsE----------	B	>40	0-20	Loamy sand----------	SM	A-2
			20-36	Sandy clay loam----------	SC or CL	A-6
			36-60	Sandy loam to sand-------	SM to SP	A-1 or A-2

SIGNIFICANT IN ENGINEERING--Continued

Percentage less than 3 inches in diameter passing sieve--				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
				Inches per hour	Inches per inch of soil	pH	Millimhos per cm.	
90-100	90-100	60-80	15-75	0.63-2.0	0.11-0.21	6.1-8.4	0-4	Low to moderate.
90-100	80-100	50-90	5-75	0.63-20.0	0.06-0.21	6.1-8.4	0-4	Low to moderate.
95-100	90-100	60-100	60-80	0.63-2.0	0.11-0.21	6.6-9.0	2-4	Low to moderate.
95-100	85-100	50-70	25-75	0.63-2.0	0.11-0.21	6.1-8.4	2-8	Low to moderate.
90-100	80-100	40-75	5-75	0.20-20.0	0.06-0.18	6.1-8.4	2-8	Low to high.
100	95-100	50-75	5-30	6.3-20.0	0.05-0.08	5.6-7.3	0-2	Low.
100	95-100	85-100	70-95	0.06-0.20	0.14-0.16	6.1-7.8	0-2	High.
100	100	90-100	70-95	0.06-0.20	0.14-0.21	7.3-9.0	2-4	High.
55-80	50-75	35-70	15-35	0.63-2.0	0.07-0.16	6.1-7.8	0-2	Low.
30-60	20-50	15-40	0-5	6.3-20.0	0.03-0.07	6.1-7.8	0-2	Low.
90-100	50-80	25-50	10-20	6.3-20.0	0.06-0.10	5.6-7.3	0-2	Low.
75-100	70-100	55-70	30-35	2.0-6.3	0.11-0.13	5.6-7.3	0-2	Low.
75-100	70-100	70-90	35-55	0.63-2.0	0.14-0.16	5.6-7.3	0-2	Moderate.
75-100	70-100	50-75	15-35	6.3-20.0	0.06-0.13	5.6-7.3	0-2	Low.
90-100	85-100	50-70	25-35	2.0-6.3	0.11-0.13	5.6-7.3	0-2	Low.
90-100	75-100	60-90	35-55	0.63-2.0	0.14-0.16	5.6-7.3	0-2	Moderate.
90-100	85-100	50-70	25-35	2.0-6.3	0.05-0.13	5.6-7.3	0-2	Low.
100	95-100	50-75	15-30	6.3-20.0	0.06-0.08	5.6-7.3	0-2	Low.
100	95-100	75-90	35-55	0.63-2.0	0.14-0.16	5.1-6.5	0-2	Low.
100	90-100	45-70	5-15	6.3-20.0	0.05-0.13	5.6-7.3	0-2	Low.

Soil series and map symbols	Hydrologic soil group	Depth to bedrock	Depth from surface	Classification		
				Dominant USDA texture	Unified	AASHO
		Inches	Inches			
*Pring: PvE---------- For Kippen part of PvE, see Kippen series.	B	>40	0-60	Gravelly sandy loam------	SM	A-1 or A-2
Razor: RaE----------	D	20-40	0-34 34	Clay---------- Shale.	CH	A-7
*Rednun: RdD, ReE--------- For Redridge part of ReE, see Redridge series.	C	>60	0-10 10-42 42-60	Loam---------- Clay---------- Loam----------	ML CL or CH ML	A-4 A-6 or A-7 A-4
*Redridge: RgF---------- For Chaseville part of RgF, see Chaseville series.	B	>60	0-26 26-60	Gravelly sandy loam------ Very gravelly loamy sand-	SM or SC SP-SM	A-1 or A-2 A-1
*Redtom: RlE---------- For Lonetree part of RlE, see Lonetree series.	B	>60	0-60	Sandy loam or loamy sand-	SM	A-1 or A-2
*Renohill: RmE, RnE------- For Buick part of RmE, see Buick series; for Manzanola part of RnE, see Manzanola series.	C	20-40	0-24 24	Clay loam---------- Shale.	CL or CH	A-6 or A-7
Renohill, reddish variant: RoE.	C	20-40	0-32 32	Clay---------- Shale.	CL or CH	A-7
Rock land: RtG. Materials too variable to be estimated. For Lonetree part of RtG, see Lonetree series.						
Sampson: Sa----------	B	>60	0-60	Clay loam, loam, and silt loam.	CL	A-4 or A-6
Sandy alluvial land: Sd---	B	>60	0-60	Loamy sand or sand-------	SP or SM	A-1

SIGNIFICANT IN ENGINEERING--Continued

Percentage less than 3 inches in diameter passing sieve--				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
				Inches per hour	Inches per inch of soil	pH	Millimhos per cm.	
95-100	60-80	35-50	15-30	2.0-6.3	0.07-0.09	5.6-7.3	0-2	Low.
100	100	90-100	75-95	0.06-0.20	0.14-0.16	7.3-9.0	4-8	High.
100	100	85-95	60-75	0.63-2.0	0.12-0.20	6.1-7.8	0-2	Low.
100	100	90-100	75-95	0.06-0.20	0.16-0.21	6.6-8.4	0-2	High.
100	100	85-95	60-75	0.63-2.0	0.12-0.20	7.4-9.0	0-2	Low.
85-100	50-80	35-75	20-35	0.63-2.0	0.12-0.16	5.6-7.3	0-2	Low.
85-100	20-50	10-30	5-12	6.3-20.0	0.04-0.08	5.6-7.3	0-2	Low.
95-100	80-100	40-75	15-35	6.3-20.0	0.06-0.13	5.6-7.3	0-2	Low.
100	100	95-100	70-80	0.06-0.20	0.19-0.21	7.3-9.0	2-4	High.
95-100	90-100	80-100	70-95	0.06-0.20	0.14-0.16	6.1-7.8	0-2	Low to moderate
100	95-100	80-100	60-80	0.20-0.63	0.17-0.20	6.1-8.4	0-2	Moderate.
50-90	30-50	15-30	5-20	6.3-20.0	0.05-0.08	6.6-8.4	0-4	Low.

TABLE 6.--ESTIMATED SOIL PROPERTIES

Soil series and map symbols	Hydrologic soil group	Depth to bedrock	Depth from surface	Classification		
				Dominant USDA texture	Unified	AASHO
		Inches	Inches			
Sandy wet alluvial land: Se.	C	>60	0-60	Loamy sand to gravelly sand.	SP or GP	A-1
Satanta: Sn----------	B	>60	0-30	Clay loam----------	CL	A-6
			30-60	Loam----------	ML	A-4
Satanta, calcareous variant: SrD, SrE.	C	40-60	0-10	Loam----------	ML	A-4
			10-50	Clay loam----------	CL	A-7
			50	Clay shale.		
*Stapleton: SsE, St------ For Bresser part of St, see Bresser series.	B	>60	0-60	Coarse sandy loam--------	SM	A-1 or A-2
Stony rough land: Su-----	D	20-40	0-20	Flaggy loam to gravelly clay loam.	(1/)	(1/)
Stony steep land: Sv-----	D	10-30	----	----------	(1/)	(1/)
Stony steep land, cold: Sw.	D	20-40	----	----------	(1/)	(1/)
Tarryall: TaF----------	B	20-40	0-30	Gravelly loam----------	SM	A-2 or A-4
			30	Limestone.		
*Tinytown: TcE---------- For Cheeseman part of TcE, see Cheeseman series.	B	>40	0-60	Gravelly sandy loam-----	SM	A-2
Tomah---------- Mapped only with Crowfoot series.	B	>60	0-22	Fine sandy loam or loamy sand.	SM	A-2
			22-60	Sand to sandy loam with sandy clay loam lamellae.	SM or SC	A-2 or A-4
Truckton: TrB, TrD-------	B	>60	0-60	Sandy loam----------	SM	A-2 or A-4
Westcreek: WeE----------	B	>60	0-16	Gravelly loam or gravelly sandy loam.	SM	A-1 or A-2
			16-48	Gravelly sandy clay loam-	SC	A-2 or A-4
			48-60	Gravelly sandy loam------	SM	A-1 or A-2

1/ Materials too variable to be estimated.

SIGNIFICANT IN ENGINEERING--Continued

Percentage less than 3 inches in diameter passing sieve--				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
				Inches per hour	Inches per inch of soil	pH	Millimhos per cm.	
35-65	20-50	10-30	0-5	6.3-20.0	0.03-0.08	6.1-8.4	2-8	Low.
100	100	90-100	70-80	0.63-2.0	0.19-0.21	5.6-7.3	0-2	Moderate.
100	80-100	70-95	50-75	0.63-2.0	0.16-0.18	6.6-8.4	0-4	Low.
95-100	90-100	75-95	60-75	0.63-2.0	0.16-0.18	7.3-9.0	0-2	Low.
100	90-100	80-100	60-80	0.63-2.0	0.19-0.21	7.3-9.0	0-2	Moderate.
90-100	50-80	35-50	15-30	2.0-6.3	0.11-0.13	6.1-7.8	0-2	Low.
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55-80	50-75	40-70	25-45	0.63-2.0	0.08-0.14	7.9-9.0	0-2	Low.
80-90	50-75	35-60	20-35	2.0-6.3	0.07-0.12	5.6-7.8	0-2	Low.
85-100	70-100	50-70	15-35	2.0-6.3	0.07-0.13	5.6-7.3	0-2	Low.
90-100	70-90	60-75	15-45	0.63-2.0	0.09-0.13	5.6-7.3	0-2	Low or moderate.
100	100	80-90	30-40	2.0-6.3	0.08-0.13	6.1-7.8	0-2	Low.
90-95	55-75	40-60	15-35	0.63-2.0	0.07-0.12	5.6-7.3	0-2	Low.
95-100	50-70	40-60	25-40	0.20-0.63	0.10-0.18	5.6-7.3	0-2	Moderate.
90-95	50-70	40-60	10-20	2.0-6.3	0.07-0.10	5.6-7.3	0-2	Low.

TABLE 7.--ENGINEERING INTERPRETATIONS

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two for this reason it is necessary to follow carefully the instructions for referring

Soil series and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Road fill	Sand and gravel	Highway location
*Blakeland: BlE, Bo--- For Orsa part of Bo, see Orsa series.	Poor---	Good---	Fair for sand; no gravel.	Fair compaction; subject to soil blowing.
*Bresser: BrB, BrD, BsE, BtE, BuD2. For Louviers part of BsE, see Louviers series; for Truckton parts of BtE and BuD2, see Truckton series.	Fair---	Fair to good---	Unsuitable---	Fair to good compaction---
Brussett: BvB, BvD---	Good---	Poor---	Unsuitable---	Poor compaction; susceptible to frost heave.
*Buick: BwD--- For Satanta part of BwD, see Satanta series.	Fair---	Poor---	Unsuitable---	Poor compaction---
Chaseville--- Mapped only with Redridge soils.	Poor---	Good---	Good for sand; poor for gravel.	Good stability; steep---
Cheeseman--- Mapped only with Tinytown soils.	Good---	Fair---	Unsuitable---	Susceptible to frost heave; low plasticity.
Coni: CoG---	Fair---	Poor---	Unsuitable---	Bedrock at a depth of less than 20 inches.
*Crowfoot: CrE--- For Tomah part of CrE, see Tomah series.	Poor to fair---	Good---	Fair to good for sand; no gravel.	Fair compaction; fair stability.
*Cruckton: CsD, CtE--- For Peyton part of CtE, see Peyton series.	Fair---	Good---	Poor to fair for sand; no gravel.	Good compaction---

or more kinds of soil. The soils in such mapping units may have different properties and limitations, and to other series that appear in the first column of this table]

Soil features affecting--Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
High seepage rate-----	Subject to soil blowing; high seepage rate.	Rapid permeability; ditchbanks unstable.	Rapid intake rate; low available water capacity.	Poor stability; poor to fair compaction.
Moderately rapid permeability below a depth of 36 inches.	Fair stability to a depth of 36 inches; subject to soil blowing.	Moderate permeability.	Moderate intake rate; moderate to high available water capacity; moderately high fertility.	Fair compaction; moderate to high permeability.
Lime below a depth of 36 inches; may need sealing.	Fair stability; tends to erode; high silt content.	Slow to moderate permeability.	Fertile; high available water capacity.	Tends to erode; high silt content.
Moderate to slow permeability.	Fair to poor stability.	Moderate permeability.	Low to moderate intake rate; high available water capacity; fertile.	Fair stability.
High seepage rate-----	Good stability; high seepage rate.	Somewhat excessively drained.	Low available water capacity; steep slopes.	Steep and sandy.
Moderate permeability; shale at a depth of 4 to 6 feet.	Fair stability; moderate erodibility.	Moderate permeability; shale at a depth of 4 to 6 feet.	Moderate intake rate; high available water capacity; moderately steep slopes.	Fair stability.
Bedrock at a depth of less than 20 inches.	Fair to poor stability; bedrock at a depth of less than 20 inches.	Well drained---------	Not applicable-------	Bedrock at a depth of less than 20 inches.
Needs compaction or sealing; moderate to rapid permeability.	Fair compaction------	Well drained---------	Rapid intake rate; low available water capacity; low fertility.	Fair stability; rapid permeability in lower part.
Needs sealing; rapid permeability.	Fair stability; rapid permeability.	Rapid permeability---	Rapid intake rate; moderately low available water capacity; undulating topography.	Fair stability; subject to soil blowing.

TABLE 7.--ENGINEERING INTERPRETATIONS

Soil series and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Road fill	Sand and gravel	Highway location
Denver: DeD	Poor	Poor	Unsuitable	High shrink-swell potential.
Englewood: En	Fair to poor	Poor	Unsuitable	High shrink-swell potential.
Falcon Mapped only with Kettle soils.	Poor	Good	Unsuitable	Bedrock at a depth of less than 20 inches.
*Fondis: FoB, FoD, Fu For Kutch part of Fu, see Kutch series.	Fair	Poor	Unsuitable	High shrink-swell potential.
Garber: GaE	Poor	Good	Fair for sand; poor for gravel.	Good stability; slopes 5 to 30 percent.
Gove: GoE, GsF Shale outcrop part of GsF unsuited for all uses.	Poor	Good	Poor	Fair to good compaction
Heldt: He	Poor	Poor	Unsuitable	High shrink-swell potential.
Hilly gravelly land: Hg	Poor	Poor	Unsuitable	Steep slopes; shale between depths of 20 and 60 inches; cobbly.
*Jarre: Jb For Brussett part of Jb, see Brussett series.	Poor	Good	Fair for sand; poor for gravel.	Good compaction
Juget: JuF, JvF	Poor	Good	Fair to poor for concrete.	Steep slopes; granite at a depth of less than 20 inches.
Kassler: Ka	Poor	Good	Fair for sand; poor for gravel.	Poor compaction

Soil features affecting--Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Low seepage----------	High shrink-swell potential.	Slow permeability----	Slow water intake rate; high available water capacity; difficult to work.	Slow permeability; cracks common.
Low seepage----------	High shrink-swell potential.	Slow permeability----	Slow water intake rate; high available water capacity.	Slow permeability.
Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.	Somewhat excessively drained.	Not applicable-------	Bedrock at a depth of less than 20 inches.
Slow permeability-----	Fair to poor stability; tends to crack.	Slow permeability----	Low intake rate; high available water capacity; high fertility.	Slow permeability; tends to crack.
Rapid permeability----	High seepage rate----	Well drained---------	Rapid intake rate; low available water capacity; low fertility.	Good stability; rapid permeability.
Moderate permeability-	High seepage rate----	Well drained---------	Low available water capacity; low fertility.	Moderate permeability.
Low seepage; in places shale is below a depth of 40 inches.	High shrink-swell potential.	Slow permeability----	Slow water intake rate; difficult to work.	High shrink-swell potential; slow permeability.
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Rapid permeability below a depth of 30 inches.	Good stability-------	Well drained---------	Moderate intake rate; moderate available water capacity; strongly sloping.	Fair compaction; moderate permeability.
Steep slopes; granite at a depth of less than 20 inches.	Granite at a depth of less than 20 inches.	Somewhat excessively drained.	Not applicable-------	Granite at a depth of less than 20 inches.
Rapid permeability----	Very high seepage rate.	Rapid permeability---	Rapid intake rate; low available water capacity; low fertility.	Rapid permeability.

TABLE 7.--ENGINEERING INTERPRETATIONS

Soil series and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Road fill	Sand and gravel	Highway location
*Kettle: KeE, KfF--------- For Falcon part of KfF, see Falcon series.	Poor----------	Good----------	Fair for sand; no gravel.	Good stability; good compaction.
*Kippen: KnE, KpD2-------- For Pring part of KpD2, see Pring series.	Poor----------	Good----------	Fair for sand; no gravel.	Fair to good compaction; subject to soil blowing.
*Kutch: KtE, KuD, KuE, KwF. For Newlin part of KwF, see Newlin series; for Stapleton part of KwF, see Stapleton series.	Poor to fair---	Poor----------	Unsuitable---------	Poor compaction; high shrink-swell potential.
Larkson: LaD----------	Poor----------	Poor----------	Unsuitable---------	High shrink-swell potential.
Loamy alluvial land: Lo---	Fair to good---	Fair----------	Unsuitable---------	Fair stability; subject to flooding.
Loamy alluvial land, dark surface: Lu.	Good----------	Fair----------	Poor but has gravel below a depth of 40 inches.	Subject to flooding-------
Loamy wet alluvial land: Lw.	Poor to fair---	Poor to fair-----	Unsuitable---------	High water table; frequent flooding.
Lonetree---------- Mapped only with Rock land.	Poor----------	Good----------	Poor to fair for sand; no gravel.	Fair to good compaction; subject to soil blowing.
Louviers---------- Mapped only with Bresser soils.	Poor----------	Poor----------	Unsuitable---------	High shrink-swell potential; shale between depths of 10 and 20 inches.
Manzanola: Ma----------	Poor----------	Poor----------	Unsuitable----------	High shrink-swell potential.

Soil features affecting--Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Moderate permeability.	Fair stability; fair compaction.	Somewhat excessively drained.	Rapid intake rate; low available water capacity; low fertility.	Fair stability; moderate permeability.
Rapid permeability--	High seepage rate; subject to soil blowing.	Somewhat excessively drained.	Rapid intake rate; low available water capacity; low fertility.	Rapid permeability; erodible.
Slow permeability; shale between depths of 20 and 40 inches.	High shrink-swell potential; tends to crack.	Slow permeability; shale between depths of 20 and 40 inches.	Slow water intake rate; shale between depths of 20 and 40 inches.	High shrink-swell potential; slow permeability.
Slow permeability---	High shrink-swell potential; tends to crack.	Well drained--------	Not applicable------	High shrink-swell potential; slow permeability.
Very high seepage rate; subject to flooding.	Fair stability; subject to flooding.	Moderate to rapid permeability.	Moderate intake rate; moderate to high fertility; subject to flooding.	Fair stability; subject to flooding.
Rapid to moderate permeability; high seepage rate.	Fair stability------	Moderate to rapid permeability; gravel or sand below a depth of 40 inches.	Moderate intake rate; moderate to high available water capacity; subject to flooding.	Moderate permeability; subject to flooding.
Moderate to rapid permeability; high water table.	Fair stability------	High water table; outlets hard to locate.	Moderate to high fertility; subject to flooding; high water table.	Subject to flooding.
Rapid permeability--	Susceptible to soil blowing.	Somewhat excessively drained.	Rapid water intake rate; low available water capacity; low fertility.	Rapid permeability; subject to soil blowing.
Shale between depths of 10 and 20 inches.	Shale between depths of 10 and 20 inches.	Well drained--------	Not applicable------	Shale between depths of 10 and 20 inches.
Slow permeability---	High shrink-swell potential.	Slow permeability---	Slow water intake rate; high available water capacity.	High shrink-swell potential.

Soil series and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Road fill	Sand and gravel	Highway location
*Newlin: NeE, NsE--------- For Satanta part of NsE, see Satanta series.	Poor----------	Fair to good-----	Good for both sand and gravel.	Gravel between depths of 20 and 40 inches.
Orsa---------- Mapped only with Blakeland soils.	Poor----------	Good----------	Poor for sand; no gravel.	Fair to good compaction; subject to soil blowing.
Perrypark: PdE----------	Good----------	Fair----------	Unsuitable----------	Fair stability----------
*Peyton: PeB, PeD, PfC, PpE, PrE2. For Pring parts of PpE and PrE2, see Pring series; for Crowfoot parts of PpE and PrE2, see Crowfoot series.	Good to fair---	Good to fair; dominantly A-2 and A-4.	Poor for sand; no gravel; 10 to 50 percent fines.	Fair stability; 1 to 25 percent slopes.
Plome: PsE----------	Poor----------	Good----------	Poor for sand; no gravel.	Fair compaction----------
*Pring: PvE---------- For Kippen part of PvE, see Kippen series.	Poor----------	Fair to good-----	Poor for sand; no gravel.	Good compaction----------
Razor: RaE----------	Poor----------	Poor----------	Unsuitable----------	High shrink-swell potential.
*Rednun: RdD, ReE--------- For Redridge part of ReE, see Redridge series.	Fair----------	Poor----------	Unsuitable----------	Poor compaction; high shrink-swell potential.
*Redridge: RgF---------- For Chaseville part of RgF, see Chaseville series.	Poor----------	Good----------	Poor for sand; no gravel.	Good compaction----------
*Redtom: RlE---------- For Lonetree part of RlE, see Lonetree series.	Poor to fair---	Good----------	Poor to fair for sand; no gravel.	Good stability; fair compaction.

Soil features affecting--Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Moderate permeability; gravel between depths of 20 and 40 inches.	Good stability------	Moderate permeability.	Rapid to moderate water intake rate; low available water capacity; moderate to low fertility.	Good stability; gravel between depths of 20 and 40 inches.
Rapid permeability---	Fair to good compaction.	Rapid permeability--	Low available water capacity; subject to soil blowing; low fertility	Good stability.
Moderate permeability.	Fair stability; subject to soil blowing.	Moderate permeability.	Moderate water intake rate; moderate available water capacity.	Fair stability; moderate permeability.
Moderate permeability.	Fair stability; subject to soil blowing.	Moderate permeability.	Moderate water intake rate; moderate to high available water capacity.	Fair stability; moderate permeability.
Moderate permeability.	Fair stability------	Moderate permeability.	Low available water capacity; low fertility.	Poor stability; moderate permeability.
Moderately rapid permeability; in places bedrock is below a depth of 40 inches.	Fair to good stability.	Moderately rapid permeability; steep slopes.	Low available water capacity; in places bedrock is below a depth of 40 inches.	Fair to good stability.
Shale between depths of 20 and 40 inches.	High shrink-swell potential.	Slow permeability---	Very slow water intake rate; steep slopes; difficult to work.	Poor stability; slow permeability.
Slow permeability---	High shrink-swell potential.	Slow permeability---	Moderately slow intake rate; high available water capacity; strongly sloping.	Moderately slow permeability.
Moderate permeability.	Fair stability------	Moderate permeability; moderate to low available water capacity; steep slopes.	Moderate to low available water capacity; steep slopes.	Moderate permeability; steep slopes.
Rapid permeability--	Good stability; fair compaction.	Rapid permeability--	Low available water capacity; low fertility.	Rapid permeability; steep slopes.

TABLE 7.--ENGINEERING INTERPRETATIONS

Soil series and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Road fill	Sand and gravel	Highway location
*Renohill: RmE, RnE---- For Buick part of RmE, see Buick series; for Manzanola part of RnE, see Manzanola series.	Poor to fair---	Poor----------	Unsuitable---------	Shale between depths of 20 and 40 inches.
Renohill, reddish variant: RoE.	Poor to fair---	Poor----------	Unsuitable---------	Shale between depths of 20 and 40 inches.
*Rock land: RtG---------- For Lonetree part of RtG, see Lonetree series.	Poor----------	Poor----------	Unsuitable---------	Bare areas of bedrock; cliffs are common.
Sampson: Sa----------	Fair to good---	Poor----------	Unsuitable---------	Poor compaction; few wet areas in some places.
Sandy alluvial land: Sd---	Poor----------	Good----------	Poor for sand; no gravel.	Subject to flooding------
Sandy wet alluvial land: Se.	Poor----------	Good----------	Good for both sand and gravel.	High water table; frequent flooding.
Satanta: Sn----------	Fair to good---	Poor----------	Unsuitable---------	Poor compaction----------
Satanta, calcareous variant: SrD, SrE.	Poor----------	Poor----------	Unsuitable---------	Shale or limestone below a depth of 40 inches; poor compaction.
*Stapleton: SsE, St---- For Bresser part of St, see Bresser series.	Poor----------	Fair to good----	Poor for sand; no gravel.	Good stability; good compaction.

Soil features affecting--Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Slow permeability; shale between depths of 20 and 40 inches.	High shrink-swell potential; shale between depths of 20 and 40 inches.	Slow permeability; moderately steep slopes; shale between depths of 20 and 40 inches.	Slow intake rate; shale between depths of 20 and 40 inches.	Moderately steep slopes; shale between depths of 20 and 40 inches.
Slow permeability; shale between depths of 20 and 40 inches.	Fair stability; fair compaction.	Slow permeability; shale between depths of 20 and 40 inches.	Slow permeability; strongly sloping; shale between depths of 20 and 40 inches.	Slow permeability; slopes of 5 to 20 percent.
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Moderately slow permeability.	Fair stability------	Moderately slow permeability.	High available water capacity; nearly level slopes; fertile.	Nearly level slopes; subject to flooding.
Rapid permeability; subject to flooding.	High erodibility----	Ditchbanks unstable; rapid permeability.	Low available water capacity; high erodibility; subject to flooding.	Rapid permeability; subject to flooding.
High water table; subject to flooding.	Poor stability; subject to flooding.	High water table; outlets hard to locate.	Low fertility; subject to flooding; high water table.	Subject to flooding.
Moderate permeability.	Fair stability------	Moderate permeability.	High available water capacity; gently sloping to strongly sloping; fertile.	Moderate permeability.
Shale or limestone below a depth of 40 inches.	Poor stability------	Underlain by shale or limestone; moderate permeability.	Moderate to low intake rate; high lime content.	Poor stability.
Moderately rapid permeability; in places bedrock is below a depth of 40 inches.	Fair stability------	Moderately rapid permeability; steep slopes.	Low available water capacity; steep slopes; in places bedrock is below a depth of 40 inches.	Moderately rapid permeability.

TABLE 7.--ENGINEERING INTERPRETATIONS

Soil series and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Road fill	Sand and gravel	Highway location
Stony rough land: Su	Poor	Poor	Unsuitable	Steep slopes; shale between depths of 20 and 60 inches; stony.
Stony steep land: Sv	Poor	Poor	Unsuitable	Steep slopes; tends to slip; large rocks and stones.
Stony steep land, cold: Sw.	Poor	Poor	Unsuitable	Steep slopes; tends to slip; large rocks and stones.
Tarryall: TaF	Poor	Poor	Unsuitable	High erodibility; steep slopes; bedrock between depths of 20 and 40 inches.
*Tinytown: TcE For Cheeseman part of TcE, see Cheeseman series.	Poor	Good	Poor for both sand and gravel.	Fair to good stability; bedrock below a depth of 40 inches.
Tomah Mapped only with Crowfoot soils.	Poor to fair	Good	Poor for sand; no gravel.	Fair to good stability; fair to good compaction.
Truckton: TrB, TrD	Poor to fair	Good	Poor for sand; no gravel.	Fair to good stability; subject to soil blowing.
Westcreek: WeE	Poor to fair	Good	Poor for sand; no gravel.	Fair to good stability; fair to good compaction.

Soil features affecting--Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
---	---	---	---	
---	---	---	---	
---	---	---	---	
Moderate permeability; steep slopes.	High erodibility----	Well drained--------	Not applicable------	Moderate permeability; steep slopes.
Moderately rapid permeability.	Fair to good stability; moderate to high erodibility.	Moderately rapid permeability.	Rapid intake rate; low available water capacity; steep slopes.	Moderately rapid permeability.
Moderate permeability.	Fair to good stability; fair to good compaction.	Well drained--------	Moderate intake rate; low available water capacity; low fertility.	Moderate permeability.
Moderately rapid permeability.	Fair to good stability; subject to soil blowing.	Moderately rapid permeability.	Moderate available water capacity; undulating to rolling topography; low fertility.	Moderately rapid permeability; subject to soil blowing.
Slopes of 10 to 30 percent; moderately slow permeability.	Fair to good stability.	Moderately slow permeability; moderate available water capacity; steep slopes.	Moderate available water capacity; steep slopes.	Steep slopes.

Reaction refers to the pH value of the soil. The soil pH gives an indication of the corrosiveness of the soil solution and the protection needed for structures, such as pipelines, when placed in the soil.

Salinity not only affects the suitability of a soil for crop production, but also its stability when used as a construction material and its corrosiveness to other materials. Salinity of the soil is based on the electrical conductivity of saturated soil extract as expressed in millimhos per centimeter at 25° C. The following ratings are used: none, less than 2.0; slight, 2.0 to 4.0; moderate, 4.0 to 8.0; and severe, 8.0 to 16.0.

Shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. In general, soils that have high shrink-swell potential present hazards to the maintenance of engineering structures constructed in, on, or with such materials. In general, soils classified as CH and A-7 have high shrink-swell potential, and clean, structureless sand and other nonplastic soil materials have low shrink-swell potential.

Engineering Interpretations of Soil Properties

Table 7 gives the suitability of soil material for certain uses and describes specific characteristics of each soil series that affect the design and application of construction operations. Some of the hazards and problems related to construction and maintenance are given in the table.

The ratings given for suitability of soil material for topsoil, roadfill, sand, and gravel apply only to the survey area. Many of the soils are rated poor or fair as a source of topsoil because the soils are eroded, are low in content of organic matter or natural fertility, or have a fine-textured and sticky topsoil that is difficult to handle or work. For those soils rated as possible sources of sand or gravel, the ratings do not take into account gradation in size or kind of minerals from which the materials were derived. Soils rated good as a suitable source of sand or gravel therefore may fail to provide the quality or gradation necessary. The ratings for roadfill indicate how the soil performs when placed in road embankments.

In general, the soil features were rated according to the extent of the problems they might cause during the construction and maintenance of highways and agricultural structures and practices. The soil features shown for a given soil were based on the profile of that soil as shown in table 6. Variation of this profile will change the ratings of the soil for use in some structures and practices.

Town and Country Planning

Urbanization has started in the Castle Rock Area. In 1956, no suburban tracts were reported. In contrast to this, in 1963, suburban tracts accounted for 9,002 acres in Douglas County.

The survey area lies between Denver and Colorado Springs. Industry of the Denver metropolitan area is starting to move into the Area from the north, and the Air Force Academy is just outside the Area on the south. The proximity of jobs, good roads across the Area, a temperate climate, and a fine panoramic view of the Rocky Mountains and foothills make the Area a desirable place to live. Land prices reflect the increased interest in urban development.

The most important factor that determines the use of the soils of the Castle Rock Area for urbanization is the availability of water. The most dependable water source is direct purchase from established municipalities and piping to the proposed site of use. Water is also available in limited quantity along the foothills from the small streams that drain the mountains west of the survey area. In the Garber-Kassler-Rockland association and the Juget-Rock land association, some water from wells is also available but is usually limited to stream bottoms. Cherry Creek and Plum Creek provide water, and along Cherry Creek and the South Platte River water is available from wells at a depth of about 100 feet. Many of these wells can produce over 400 gallons per minute and can be developed to supply homes. Some wells producing 100 gallons a minute or less are also available along Plum Creek.

Water for domestic purposes is also available from wells throughout most of the rest of the Area. In many places it is necessary to go to a depth of 300 feet or more, and the location must be chosen with care. In the southern part of the Area at elevations above 6,600 feet there are some springs that can be developed for domestic use. Dams or collection basins for rainwater can also be constructed to meet domestic needs for individual homes in the higher parts of the Area, particularly where rock is close to the surface.

Table 8 shows the estimated ratings of the degree and kind of limitations of each soil in the Area important for urban uses. A rating of slight indicates that the soil has few limitations and that they are easily overcome. A soil rated moderate has limitations that can be overcome but that requires special management practices. A rating of severe indicates serious limitations requiring extensive management practices. This rating does not imply that the soil cannot be used for the purpose stated. Where the rating is severe, however, the cost involved in overcoming the limitations may not be justified. The ratings given in the table are generalized and should be used primarily in planning more detailed field investigation at the proposed site to determine the characteristics of the soil material. The section "Engineering Uses of the Soils" contains some detailed information needed for engineering design.

The criteria used in determining the degree and kind of limitation to various uses shown in table 8 are discussed in the following paragraphs.

The septic tank absorption field is the soil absorption system for sewage disposal. It consists of subsurface tile laid in such a way that effluent

the septic tank is distributed with reasonable uniformity into the natural soil. The limitations for use as an absorption field are local experience and records of performance of existing filter fields; permeability of the subsoil and substratum; depth to consolidated rock or other impervious layers; flooding; seasonal and annual ground water level; and soil slope. Sandy soils, such as Blakeland sandy loam, 1 to 15 percent slopes, and soils having rapid permeability have few limitations for absorption fields. Although soils with rapid permeability have few limitations, it should be noted that a contamination hazard may exist if water supplies, streams, ponds, lakes, or water courses are nearby and receive seepage from the absorption field.

A sewage lagoon is usually built to dispose of sewage in areas where septic tanks or other sewage systems are not feasible. It is a shallow pond that holds sewage for the time required for bacterial decomposition. The limitations of a soil for basin floors of lagoons are slow rate of seepage; even surface of low gradient and low relief; and little or no organic matter.

Shallow excavations are those that require excavating or trenching to a depth of 5 to 6 feet or less. Such uses include underground utility lines, cementeries, basements, and open ditches. Desirable soil qualities and characteristics are good workability, moderate resistance to slighing, gentle slopes, absence of rock outcrops and big stones, and absence of flooding.

Dwellings without basements are homes and other buildings less than three stories high. The limitations of a soil are stability, bearing capacity, shrink-swell properties, depth to water table, natural drainage, hazard of flooding, seasonal wetness, and slope.

Slope is an important factor in considering a building site. Erosion is common on slopes exceeding 3 percent, especially in the initial stage of construction. Clayey soils with slopes of more than 9 percent and sandy soils, such as Peyton-Pring-Crowfoot sandy loams, with slopes over 20 percent, tend to slip when saturated with water. These areas should have retaining walls to hold the soil if slopes are increased to more than 10 to 20 percent in excavating for building sites.

The local roads and streets referred to in the table have some kind of all-weather surfacing, commonly asphalt or concrete. They are expected to carry automobile traffic year-around, but are not expected to carry fast-moving, heavy trucks.

Soil features evaluated in determining ratings for drainage are hazard of flooding, slope, shrink-swell and bearing properties, and degree of stoniness and rockiness.

Shrubs and trees in landscape plantings and lawns and golf fairways refer to the limitations of soils to support lawns, trees, and shrubs. Where soils are thin over rock, as in Coni rocky loam, 3 to 100 percent slopes, rooting depth for trees and shrubs is limited and soil slippage is prevalent.

TABLE 8.--LIMITATIONS OF THE SOILS

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or this reason it is necessary to follow carefully the instructions for referring

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
Blakeland: BlE, Bo--------- For Orsa part of Bo, see Orsa series.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent.	Severe: rapid permeability.	Severe: sandy texture---
* Bresser: BrB, BrD----------	Slight----------	Moderate: moderate permeability.	Slight----------
BsE, BtE, BuD2---------- For Louviers part of BsE, see Louviers series; for Truckton part of BtE and BuD2, see Truckton series.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate permeability.	Slight----------
Brussett: BvB----------	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate to a depth of 26 inches; slight below a depth of 26 inches; clay loam texture.
BvD----------	Moderate: moderate permeability.	Moderate: moderate permeability; severe where slope is more than 7 percent.	Moderate: moderate permeability; severe where slope is more than 7 percent.
* Buick: BwD---------- For Satanta part of BwD, see Satanta series.	Moderate: moderate permeability.	Moderate: moderate permeability; severe where slope is more than 7 percent.	Slight----------
Chaseville---------- Mapped only with Redridge soils.	Severe: steep slopes----	Severe: rapid permeability; steep slopes.	Severe: steep slopes; gravelly and sandy texture.
Cheeseman---------- Mapped only with Tinytown soils.	Severe: shale is between a depth of 20 and 40 inches; slope.	Severe: shale is between a depth of 20 and 40 inches; slope.	Severe: shale is between a depth of 20 and 40 inches; slope.

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for to other series that appear in the first column of this table]

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Moderate: 3 to 6 inches available water capacity within a depth of 60 inches.	Slight where slope is less than 2 percent; moderate where slope is 2 to 15 percent.
Slight----------	Slight----------	Slight----------	Slight where slope is less than 2 percent; moderate where slope is more than 2 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent.
Moderate: unified soil group CL.	Moderate: unified soil group CL; moderate to high plasticity index.	Slight----------	Slight in most places; moderate where slope is 2 to 3 percent.
Moderate: moderate permeability; severe where slope is more than 7 percent.	Moderate: moderate permeability; severe where slope is more than 7 percent.	Slight----------	Moderate: slope.
Moderate: unified soil group CL.	Moderate: unified soil group CL.	Slight----------	Moderate: slope.
Severe: steep slopes-----	Severe: steep slopes-----	Moderate: available water capacity is 4 to 5 inches.	Severe: steep slopes.
Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent; shale is between a depth of 20 and 40 inches.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent; shale is between a depth of 20 and 40 inches.	Moderate: shale is between a depth of 20 and 40 inches.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent; clay loam texture.

TABLE 8.--LIMITATIONS OF THE SOILS

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
Coni: CoG----------	Severe: bedrock is at a depth of less than 20 inches; slope.	Severe: bedrock is at a depth of less than 20 inches; slope.	Severe: bedrock is at a depth of less than 20 inches; slope.
Crowfoot: CrE---------- For Tomah part of CrE, see Tomah series.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
Cruckton: CsD----------	Slight----------	Severe: moderately rapid permeability.	Slight----------
CtE---------- For Peyton part of CtE, see Peyton series (PeD).	Moderate to severe; slope.	Severe: moderately rapid permeability; slope.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
Denver: DeD----------	Severe: slow permeability.	Moderate where slope is less than 7 percent; severe where slope is more than 7 percent.	Severe: clay and silty clay textures; slope.
Englewood: En----------	Severe: slow permeability.	Slight where slope is less than 2 percent; moderate where slope is 2 to 4 percent.	Severe: clay texture---
Falcon---------- Mapped only with Kettle soils.	Severe: bedrock is at a depth of less than 20 inches.	Severe: bedrock is at a depth of less than 20 inches.	Severe: bedrock is at a depth of less than 20 inches.
* Fondis: FoB, FoD, Fu------- For Kutch part of Fu, see Kutch series.	Severe: slow permeability.	Slight where slope is less than 2 percent; moderate where slope is 2 to 7 percent; severe where slope is more than 7 percent.	Moderate where texture is clay loam; severe where texture is clay.
Garber: GaE----------	Pollution is a hazard in places because of permeability in substratum. Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Severe: very gravelly sandy loam texture.

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Severe: bedrock is at a depth of less than 20 inches; slope.	Severe: bedrock is at a depth of less than 20 inches; slope.	Severe: bedrock is at a depth of less than 20 inches.	Severe: bedrock is at a depth of less than 20 inches.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent; loamy sand texture.
Slight----------	Slight----------	Slight----------	Slight where slope is less than 2 percent; moderate where slope is 2 to 9 percent.
Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent.
Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderate: slow permeability.	Moderate: slow permeability; slope.
Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderate: slow permeability.	Moderate: slow permeability.
Severe: bedrock is at a depth of less than 20 inches.	Severe: bedrock is at a depth of less than 20 inches.	Severe: bedrock is at a depth of less than 20 inches.	Severe: bedrock is at a depth of less than 20 inches.
Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderate: slow permeability.	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent; slow permeability.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderately low available water capacity.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent; gravelly soils.

TABLE 8.--LIMITATIONS OF THE

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
Gove: GoE, GsF---------- Shale outcrop part of GsF is severe for all uses.	Pollution is a hazard in places because of permeability in substratum. Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: moderately rapid permeability and moderate permeability; slope.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
Heldt: He----------	Severe: slow permeability.	Slight where slope is less than 2 percent; moderate where slope is more than 2 percent.	Severe: clay texture----
*Hilly gravelly land: Hg----	Severe: slow permeability; shale is between a depth of 20 and 40 inches; slope.	Severe: cobbly soils; slope.	Severe: cobbly soils; shale is between a depth of 20 and 40 inches; slope.
Jarre: Jb---------- For Brussett part of Jb, see Brussett series (BvD).	Pollution is a hazard in places because of permeability in substratum. Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Moderate where slope is less than 15 percent; severe where slope is more than 15 percent; gravelly soils.
Juget: JuF, JvF----------	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.
Kassler: Ka----------	Slight; pollution is a hazard in places because of permeability in substratum.	Severe: rapid permeability.	Severe: very gravelly soils.
*Kettle: KeE, KfF---------- For Falcon part of KfF, see Falcon series.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability.	Severe: coarse loamy sand texture; slope.
*Kippen: KnE, KpD2---------- For Pring part of KpD2, see Pring series.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability.	Severe: loamy sand and sand textures; slope.

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderate: slow permeability.	Moderate: slow permeability.
Severe: high shrink-swell potential; slope.	Severe: high shrink-swell potential; slope.	Moderate: slow permeability; shale between a depth of 20 and 40 inches.	Severe: cobbly soils; slope.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent; rapid permeability.
Severe: slope; shallow to bedrock. Severe: flooding in places.	Severe: slope; shallow to bedrock. Severe: flooding in places.	Severe: slope; shallow to bedrock. Severe: low available water capacity.	Severe: slope; shallow to bedrock. Severe: very gravelly soils.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slopes are 5 to 15 percent; severe where slopes are more than 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: rapid permeability; low available water capacity.	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent; rapid permeability.

TABLE 8.--LIMITATIONS OF THE SOILS FOR

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
*Kutch: KtE----------	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.
KuD, KuE, KwF---------- For Newlin and Stapleton parts of KwF, see Newlin and Stapleton series, respectively.	Severe: slow permeability; shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.
Larkson: LaD----------	Severe: slow permeability.	Moderate where slope is 2 to 7 percent; severe where slope is more than 7 percent; shale is below a depth of 40 inches.	Moderate: shale is below a depth of 40 inches.
Loamy alluvial land: Lo-----	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.
Loamy alluvial land, dark surface: Lu.	Severe: subject to flooding; variable water table.	Severe: subject to flooding; variable water table.	Severe: subject to flooding; variable water table.
Loamy wet alluvial land: Lw-	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.
Lonetree---------- Mapped only with Rock land.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Severe: sandy texture; slope.
Louviers---------- Mapped only with Bresser soils.	Severe: shale is between depths of 10 and 20 inches.	Severe: shale is between depths of 10 and 20 inches.	Severe: shale is between depths of 10 and 20 inches.
Manzanola: Ma----------	Severe: slow permeability.	Moderate: slope----------	Severe: clay texture---
*Newlin: NeE, NsE---------- For Satanta part of NsE, see Satanta series.	Pollution is a hazard in places because of permeability in substratum; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Severe: sand and gravel below a depth of 20 inches.

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Severe: high shrink-swell potential below a depth of 7 inches; shale is between a depth of 20 and 40 inches.	Severe: high shrink-swell potential below a depth of 7 inches; shale is between a depth of 20 and 40 inches.	Moderate: slow permeability; shale is between a depth of 20 and 40 inches.	Moderate where slope is 4 to 15 percent; severe where slope is more than 15 percent; slow permeability.
Severe: high shrink-swell potential; shale is between a depth of 20 and 40 inches; slope.	Severe: high shrink-swell potential; slope.	Moderate: slow permeability.	Severe: slope.
Severe: high shrink-swell potential between a depth of 8 and 24 inches.	Severe: high shrink-swell potential between a depth of 8 and 24 inches.	Slight----------	Moderate: slow permeability in subsoil; slope.
Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Slight----------	Severe: subject to frequent flooding.
Severe: subject to flooding; variable water table.	Severe: subject to flooding; variable water table.	Slight----------	Severe: subject to frequent flooding.
Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent; rapid permeability.
Severe: shale is between depths of 10 and 20 inches.	Severe: shale is between depths of 10 and 20 inches.	Severe: low available water capacity.	Severe: bedrock is at a depth of less than 20 inches; slope.
Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderate: slow permeability.	Moderate: slow permeability.
Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.

TABLE 8.--LIMITATIONS OF THE SOILS

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
Orsa---------- Mapped only with Blakeland soils.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent.	Severe: rapid permeability.	Severe: sandy texture---
Perrypark: PdE----------	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability below a depth of 36 inches; slope.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
* Peyton:			
PeB----------	Slight----------	Moderate: moderate permeability.	Slight----------
PeD----------	Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Moderate: moderate permeability; severe where slope is more than 7 percent.	Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.
PfC----------	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.
PpE, PrE2---------- For Pring and Crowfoot parts of PpE and PrE2, see Pring and Crowfoot series respectively.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate where slope is less than 7 percent; severe where slope is more than 7 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
Plome: PsE----------	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
*Pring: PvE---------- For Kippen part of PvE, see Kippen series.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: moderately rapid permeability; slope.	Moderate: gravelly soils; severe where slope is more than 15 percent.
Razor: RaE----------	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Moderate: available water capacity within a depth of 60 inches.	Slight where slope is less than 2 percent; moderate where slope is 2 to 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate: rapid permeability below a depth of 36 inches; slope.
Slight----------	Slight----------	Slight----------	Slight.
Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Slight where slope is less than 8 percent; moderate where slope is more than 8 percent.	Slight----------	Moderate: slope.
Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.	Severe: subject to flooding; variable water table above a depth of 60 inches.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent.
Severe: high shrink-swell potential; shale is between a depth of 20 and 40 inches.	Severe: high shrink-swell potential; shale is between a depth of 20 and 40 inches.	Severe: saline; shale is between a depth of 20 and 40 inches.	Moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent; slow permeability.

TABLE 8.--LIMITATIONS OF THE SOILS

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
*Rednun: RdD, ReE---------- For Redridge part of ReE, see Redridge series.	Severe: slow permeability.	Moderate where slope is less than 7 percent; severe where slope is more than 7 percent.	Severe: clay texture; slope.
*Redridge: RgF---------- For Chaseville part of RgF, see Chaseville series.	Pollution is a hazard in places because of permeability in substratum; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: slope; rapid permeability.	Severe: very gravelly texture; slope.
*Redtom: RlE---------- For Lonetree part of RlE, see Lonetree series.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability; slope.	Severe: sandy texture; slope.
*Renohill: RmE, RnE-------- For Buick part of RmE, see Buick series; for Manzanola part of RnE, see Manzanola series.	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.
Renohill, reddish variant: RoE.	Severe: slow permeability; slope.	Severe: shale is between a depth of 20 and 40 inches; slope.	Severe: shale is between a depth of 20 and 40 inches; slope.
*Rock land: RtG. Rock land part of RtG is severe for all uses; for Lonetree part of RtG, see Lonetree series.			
Sampson: Sa----------	Moderate: moderate permeability.	Moderate: moderate permeability; slope.	Moderate: clay loam texture.
Sandy alluvial land: Sd---	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.
Sandy wet alluvial land: Se.	Severe: frequent flooding; high water table.	Severe: frequent flooding; high water table.	Severe: frequent flooding; high water table.
Satanta: Sn----------	Moderate: moderate permeability; severe where slope is more than 15 percent.	Moderate: moderate permeability; severe where slope is more than 7 percent.	Moderate: clay loam texture; severe where slope is more than 15 percent.

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Severe: high shrink-swell potential; slope.	Severe: high shrink-swell potential; slope.	Moderate: slow permeability.	Moderate: slow permeability; slope.
Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 10 to 15 percent; severe where slope is more than 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent; rapid permeability.
Severe: shale is between a depth of 20 and 40 inches.	Severe: shale is between a depth of 20 and 40 inches.	Moderate: shale is between a depth of 20 and 40 inches; slow permeability.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Severe: shale is between a depth of 20 and 40 inches; slope.	Severe: shale is between a depth of 20 and 40 inches; slope.	Moderate: slow permeability.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Moderate: unified soil group CL.	Moderate: unified soil group CL.	Slight----------	Slight.
Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.
Severe: frequent flooding; high water table.	Severe: frequent flooding; high water table.	Severe: frequent flooding; high water table.	Severe: frequent flooding; high water table.
Moderate: unified soil group CL; severe where slope is more than 15 percent.	Moderate: unified soil group CL; severe where slope is more than 15 percent.	Slight----------	Slight where slope is 0 to 2 percent; moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent.

TABLE 8.--LIMITATIONS OF THE SOILS

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
Satanta, calcareous variant: SrD, SrE.	Moderate: moderate permeability; severe where slope is more than 15 percent.	Moderate: moderate permeability; severe where slope is more than 7 percent.	Moderate: clay loam texture; severe where slope is more than 15 percent.
* Stapleton: SsE, St-------- For Bresser part of St, see Bresser series.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: moderately rapid permeability; slope.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.
Stony rough land: Su------	Severe: bedrock is at a depth of less than 40 inches; slope.	Severe: bedrock is at a depth of less than 40 inches; slope.	Severe: bedrock is at a depth of less than 40 inches; slope.
Stony steep land: Sv------	Severe: bedrock is between depth of 10 and 30 inches; slope; soil slippage.	Severe: bedrock is between depths of 10 and 30 inches; slope; soil slippage.	Severe: bedrock is between depths of 10 and 30 inches; slope; soil slippage.
Stony steep land, cold: Sw-	Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.	Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.	Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.
Tarryall: TaF----------	Severe: bedrock is at a depth of less than 40 inches; slope.	Severe: bedrock is at a depth of less than 40 inches; slope.	Severe: bedrock is at a depth of less than 40 inches; slope.
* Tinytown: TcE---------- For Cheeseman part of TcE, see Cheeseman series.	Pollution is a hazard in places because of permeability in substratum; slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: moderately rapid permeability; slope.	Moderate: gravelly texture; severe where slope is more than 15 percent.
Tomah---------- Mapped only with Crowfoot soils.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: rapid permeability.	Severe: sandy texture---
Truckton: TrB, TrD--------	Slight----------	Severe: moderately rapid permeability.	Slight----------

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Moderate: unified soil group CL; severe where slope is more than 15 percent.	Moderate: unified soil group CL; severe where slope is more than 15 percent.	Slight----------	Slight where slope is 0 to 2 percent; moderate where slope is 2 to 15 percent; severe where slope is more than 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderately low available water capacity.	Moderate where slope is 6 to 15 percent; severe where slope is more than 15 percent.
Severe: class 4 stoniness; bedrock is between a depth of 20 and 40 inches; slope.	Severe: class 4 stoniness.	Moderate: moderate available water capacity.	Severe: slope.
Severe: bedrock is between depths of 10 and 30 inches; slope; soil slippage.	Severe: bedrock is between depths of 10 and 30 inches; slope; soil slippage.	Severe: bedrock is between depths of 10 and 30 inches; slope; soil slippage.	Severe: bedrock is between depths of 10 and 30 inches; slope; soil slippage.
Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.	Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.	Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.	Severe: bedrock is between depths of 20 and 40 inches; slope; soil slippage.
Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent; bedrock is between depths of 20 and 40 inches.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent; slope.	Moderate: bedrock is between depths of 20 and 40 inches.	Severe: slope.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderately rapid permeability.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight where slope is less than 8 percent; moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate: moderate available water capacity.	Moderate where slope is 5 to 15 percent; severe where slope is more than 15 percent.
Slight----------	Slight----------	Slight----------	Slight where slope is 1 to 2 percent; moderate where slope is more than 2 percent.

TABLE 8.--LIMITATIONS OF THE SOILS

Soil series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations
Westcreek: WeE----------	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Severe: slope----------	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.

FORMATION AND CLASSIFICATION OF THE SOILS[8/]

In this section the factors that affect the formation of the soils in the Castle Rock Area are discussed, the classification of the soils into categories of the taxonomic system is given, and the character of each of the categories is briefly described.

Factors of Soil Formation

Soil is a natural body at the surface of the earth that has properties which result from action of the forces of the environment upon parent materials over a period of time. Because it is a dynamic body, the character of the soil differs from place to place in the landscape, depending upon the nature and intensity of the factors that controlled soil formation.

Five major factors influence the formation of the soil in its virgin state at any specific location. These are climate, living organisms, time, relief, and parent material. All of these factors are highly complex. Kinds of climate and combinations of living organisms are many. Parent materials vary widely in physical, chemical, and mineralogical properties, and length of time that these factors have been active varies greatly.

These five factors influence soil formation in the undisturbed landscape, but a sixth factor--man and his activities--must be added to complete the list. Man's activity is all too often destructive, and he drastically alters the properties of the soil by such physical processes as mixing, removal, and fertilization; or he alters the natural environment by controlling water and vegetation.

The history of the development of soil characteristics and the study of the interaction of the formative forces is called soil genesis. The characteristics themselves constitute the soil's morphology. Thus, the color of the soil is one feature of soil morphology. The processes that form such color are part of the soil's genesis.

It is impossible to precisely reconstruct the history of a soil's formation from the limited data available at any one location. To do so would require observing the soil and its environment throughout the entire period of soil formation, which for most soils is several thousand years. Since this is impossible, any reconstruction of the soil's genesis must be based on interpretations. These are drawn from the soil's morphology and our accumulated knowledge of how such morphology could most logically have occurred.

The system of soil classification used in the United States is based entirely upon morphological features of the soil. These are properties that can be observed or measured, and that are used to group similar soils or separate those that are dissimilar. The kinds of properties and their parameters that are to be selected as definitive between soils is guided by our knowledge of significant indicators of major differences in genesis. Thus, the two are closely interrelated, and both are essential to a good classification system.

In the following sections a general evaluation of the factors that influence soil formation in the Castle Rock Area is given, and the manner in which soil morphology has been used to group the soils into the units of classification is outlined.

Climate

The climate of the Castle Rock Area is of a semiarid, continental type. Winters are cold and dry, and summers are cool and relatively dry. Mean annual air temperature as measured at the Castle Rock weather station is 46.8° F., and mean summer air temperature is 65.8° F. Elevation within the Area is lowest at the northern and eastern borders and increases to the south and west. Air temperature and annual

8/ Written by ARVARD J. CLINE, senior soil correlator, Soil Conservation Service.

Dwellings without basements	Local roads and streets	Shrubs and trees in landscape plantings	Lawns and golf fairways
Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Moderate where slope is 8 to 15 percent; severe where slope is more than 15 percent.	Slight----------	Moderate where slope is 10 to 15 percent; severe where slope is more than 15 percent; gravelly soils.

precipitation conform to the same pattern, and temperature becomes cooler and precipitation increases as elevation increases.

The weather station at Denver just to the north of the Area has mean annual air temperature of 49.5° F., mean summer air temperatures of 70.3° F., and average annual precipitation of 14.8 inches. The station at Monument to the south of the Area has mean annual air temperature of 44° F., mean summer air temperature of 63.4° F., and average annual precipitation of 20 inches. Monument is about 2,100 feet higher than Denver.

In the Castle Rock Area seventeen sites were selected for soil temperature measurements. These measurements yield a somewhat better evalution of soil temperature than do interpretations based on air temperatures. These sites range in elevation from 5,450 feet to 7,250 feet. The mean annual soil temperature consistently decreases about 0.4° F., for each 100 feet of increase in elevation. At 5,450 feet the mean annual soil temperature measured at a depth of 20 inches was 53.5° F., and at 7,250 feet, it was about 46.0° F.

The mean summer soil temperature was less consistently related to elevation than to mean annual soil temperature. It ranged from 68.7° F. at 5,450 feet elevation to 58.6° F. at 7,250 feet. This is an average decrease of about 0.5° F. for each 100 feet rise in elevation.

The Castle Rock Area receives its greatest precipitation during spring and summer. Autumn and winter are comparatively dry, and an average of only 2 inches of precipitation falls during the period December through February. Starting in December, precipitation exceeds losses from evapotranspiration, and some moisture will be stored within the soil. This trend continues through winter and into late April or early May. At this time evapotranspiration rates start to increase rapidly. In spite of the increased precipitation during spring and summer, evapotranspiration exceeds the amount of moisture received as rain, and by mid or late July the soils are dry except for relatively brief periods following summer rains.

The amount of water available and the distribution of supplies of soil moisture relative to soil temperature and to periods of maximum biological activity are of prime importance to soil formation. The combinations of these factors contribute to the accumulation of organic matter in soil, to the physical movement of substances in suspension or solution, and to controlling the rate of chemical processes. Based upon our present knowledge of these combinations of factors, we can conclude that for a considerable period of the soils' history, the climate was more moist than the recorded present precipitation at the Castle Rock station indicates.

The effectiveness of available soil moisture is more significant to our evaluation of soil formation than is the amount of yearly precipitation. In the areas of higher elevation the amount of yearly precipitation is greater than at areas of lower elevation, and the evapotranspiration rate is less. At the higher elevations a somewhat greater amount of soil moisture therefore is available for leaching processes.

The relationship between temperature and soil formation is more obscure and cannot be as easily demonstrated as a separate force. Mainly temperature affects growth of vegetation and physical soil properties. Forty-one degrees Fahrenheit is commonly accepted as the temperature separating periods of low biologic activity from those of high activity.

At the lowest elevations of the Area, the period that the soil temperature at a depth of 20 inches exceeds 41° F. is about 297 days of the year, and the soils are rarely below 32° F. during the rest of the year. At the higher elevations, the period that the soil temperature at a depth of 20 inches exceeds 41° F. is about 210 days, and the soils are at or slightly below 32° F. for about 45 of the remaining days. The periods in which genetic forces dependent upon temperature are most effective are shorter for the higher elevation than for the lower ones.

Physical changes introduced into the soil as a result of freezing and thawing influence soil properties and formation. Certain forms of soil structure are enhanced by freezing and thawing, and these in turn influence permeability, aeration, and resistance to erosion. Horizons that are frozen during winter affect moisture distribution and intake. All of these factors should be more active at the higher elevations than at the lower ones

In the system of taxonomy, soil temperature affects the classification of soils in that the 47° F. soil temperature isotherm is used as a criterion for separating some soil subgroups. This parameter cannot be directly related to soil properties of the Castle Rock Area, but it does have a pronounced effect on cropping patterns and potentials because it controls planting dates, maturing dates, and rates of growth.

Other effects of temperature and moisture on the formation of the soils of the Area probably exist, but it is impossible to evaluate them with reasonable precision. It is more important to an understanding of soil formation not to attempt to consider temperature, precipitation, humidity, and wind action as separate factors, but rather to consider them as combined effects.

Living Organisms

Living organisms that affect soil formation can be divided on the basis of size into macro and micro groups. The macroorganisms are the visible plants and animals that live in or on the soil. Micro-organisms are those too small to be seen by the naked eye. Both kinds of organism have a pronounced effect on soil formation, but the effect of animal life is apt to be in specific local areas.

The Castle Rock Area is a transitional area between grassland and forest. Elevations within the survey area gradually increase to the south and west. In this same general direction a gradual transition is evident between areas that are covered primarily by grass to areas that have forests.

In the northern and eastern parts of the Area, the vegetation is primarily grasses, and soils have the properties expected for those formed under grass. These properties indicate that grass has persisted throughout the major part of the soils' history, or at least for a period long enough to obliterate properties related to other kinds of vegetation. Soils formed under grass have a yearly return of organic matter which decomposes in the presence of an abundance of calcium ions.

The grass vegetation returns a large amount of organic matter to the soil by the decomposition of the plant root system, as well as by yearly additions to the surface. Consequently, dark-colored horizons relatively high in organic-matter content may extend well into the soil instead of being in only the surface horizons.

The amount of vegetation varies from place to place in the landscape depending upon the amount of available soil moisture, and thus minor soil differences resulting from different amounts of vegetation are common. The soils with darker surface horizons and those where dark colors extend for greater depth generally occupy the more level or slightly concave parts of the landscape where more soil moisture is available.

In the Castle Rock Area, soils formed under forest also have a yearly return of organic matter which decomposes in the presence of calcium ions. Because the forest is relatively open and has an undergrowth of shrubs and grasses, the soils do not have the acid characteristics common to many soils formed under forest. The amount of organic matter that is returned yearly and the speed with which it decomposes into stable forms is considerably less in the forested parts of the Area than in the parts under grass. Consequently, the soils generally have either very thin dark-colored horizons or light-colored horizons in which the amount of organic matter decreases sharply as depth increases. Even though the soils formed under forest in the Castle Rock Area are not highly acid and do not have organic matter like that of other forested soils, the organic matter is concentrated, nevertheless, in the upper few inches and is underlain by light-colored horizons showing obvious leaching of organic matter.

The transitional areas between the typical grass vegetation and the typical forest vegetation apparently fluctuated over long periods of time so that some soils show evidence of having formed under both kinds of vegetation. In these soils the light-colored leached horizons considered typical of soils formed under coniferous forest still remain, but they have a relatively thick and dark-colored A1 horizon that has all the properties considered normal for soils formed under grass. These kinds of soils are not extensive, but they indicate the likelihood of fluctuating kinds of vegetation in the transitional areas.

The effect of living animal life on the soils of the Castle Rock Area is less easily demonstrated because it is nearly uniform for most soils of the Area. Careful examination of the soils in almost any location shows some evidence of mechanical mixing by earthworms, ants, or burrowing rodents. The common prairie dog has been nearly eradicated from this Area, but some areas of soil mixing within old prairie dog towns can still be found in grassed areas. The activity of insects, worms, and rodents is widespread, but there is some selectivity shown for certain soils. Thus, wet soils show less gopher activity than dry ones, and worms or insects tend to select soils having temperatures that are best suited to their habits.

The microbiological activity in the soils of the Castle Rock Area is a subject about which we have very little specific information. Organisms best adapted to neutral or alkaline reaction, to alternate periods of wetness and drying, and to seasonal ranges of soil temperature probably predominate throughout the entire Area. Bacterial strains active in the breakdown of organic material in alkaline environments and those active in the symbiotic fixation of nitrogen play important roles in most soils of the Area.

Time

Time refers to the length of time the other soil-forming factors have been active. Normally a long period of time is required for development of soils having well-defined horizons. Mature soils generally have a well defined A and B horizon and horizons

where calcium carbonate has accumulated. Soils considered young are those on which the soil-forming factors have not been active for a long time. These soils have weakly expressed horizons, and in most places they lack a B horizon. The chronological age of the soil at any one location is not easily measured, however, and the age of the soil can be stated only in relative terms based on comparisons of soil morphology.

Precise data on the chronological age of the soils of the Castle Rock Area are lacking, and therefore the landscapes have been grouped into three general age groups based primarily on the estimated chronological age of the parent materials:

(1) flood plains, low terraces, and adjoining alluvial fans of drainage systems;

(2) normal upland areas in which the soil parent materials are pedisediments of Tertiary and Pleistocene age on fans at the base of the Rocky Mountains, or in which parent material of considerable thickness has weathered from underlying bedrock; and

(3) tablelands of old alluvial fans that are polylithologic in character and have evidence of more than one period of soil formation.

In age groups 2 and 3, some soils that have weakly expressed horizons are in landscapes that are old chronologically. This is because these soils are in parts of the landscape where geologic erosion has kept pace with soil formation. Consequently, soils with distinctly expressed horizons cannot form, even though the landscape may be very old.

The first of these groups is in moderate acreages along the major streams and small drainageways of the Area. In terms of soil formation these soils are young in that they have little expressions of horizons other than a darkened surface layer or weak and varying accumulations of calcium carbonate or other soluble salts. The flood plains and low terraces of many streams are still actively building, and they receive additional deposits of material with each flood. The soils of such areas are commonly so young that distinctly darkened A horizons have not formed. The higher terraces, alluvial fans, and side slopes are somewhat more stable, and the soils generally have a distinct A1 horizon. In a few places soils of this age group have B2 horizons where changes in color, structure, or the translocation of organic matter are evidence of a slight degree of alteration of the parent material.

The soils of the second group are older than those of the first, and most of the soil pattern is dominated by soils having distinctly expressed horizons typical of either grass or forest vegetation. In the grasslands, soils of this age group have a thick, moderately dark colored A horizon and a distinct B horizon in which silicate clay has accumulated. Where the parent material originally contained free calcium carbonate, the soils have a distinct and continuous horizon of secondary calcium carbonate accumulation. Many of the parent materials of the soils of this age group are low in carbonates, and thus such horizons may be lacking, although this does not necessarily indicate a difference in chronological age.

The soils of the third age group formed on old outwash fans or terraces covered by younger deposits of eolian material or silty outwash. The chronological age of the material in the upper part of these areas is about the same as the age of the second group, but the total time involved in deposition of the material is believed to be longer.

The properties of the soils of this group are distinctive. Apparently the older outwash sediments were in place long enough to have distinct soils formed in them. The second and younger deposit has also been in place long enough to have formed a distinct solum. The second deposits were relatively thin, and the soils formed in them merged with those in the older deposit. In places all of the horizons of the older soils are difficult to distinguish, because they have been modified or obliterated by the formation of the second soil.

In some areas the line of contact between the soils in the two deposits can be easily distinguished. Nevertheless, the resulting soil has a moderately thick, relatively dark-colored surface horizon, an upper B2t horizon of silicate clay accumulation, and a second horizon of silicate clay accumulation that gradually grades at considerable depth to the unaltered parent materials. Free calcium carbonate has been leached from the younger deposit and has been redeposited in the horizon of silicate clay accumulation of the older soil, so that visible coats of secondary calcium carbonate are on the peds and fill the spaces between peds. The interiors of the ped remain noncalcareous. In most places second horizons of secondary calcium carbonate accumulation are usually beneath the buried soils.

Relief

In the Castle Rock Area soil formation is affected by relief, mainly as a result of the control of soil moisture by land form or slope gradient. The steepness of the soil slope, its position relative to other kinds of soils, and the contour of its surface all affect supplies of soil moisture, and subsequently the formation of the soils.

Soils on moderately sloping landscapes lose by runoff a part of the yearly moisture supply that they receive from precipitation. Consequently, less soil moisture is available to leach the soil, to move colloidal substances, or to support vegetation. The moderately sloping soils of the Castle Rock Area are generally thinner, and lighter colored, and have less well expressed horizons than do gently sloping soils.

Steeply sloping soils not only lose much of the yearly moisture supply, but also erode each year. Usually such erosion is not rapid enough to be readily noticeable in a given year, but over a long period of time it removes enough soil to prevent distinct soil horizons from forming.

Gently sloping soils on lower foot slopes and below areas where runoff is rapid receive both the precipitation that falls on them and that which runs off the higher areas. Consequently, such soils have more water available for soil-forming processes than that supplied by normal precipitations. In the Castle Rock Area, soils on these kinds of positions tend to be thicker, dark colored, more leached, and to have stronger expression of horizons than do the steeper soils.

Parts of the landscape that have concave surfaces tend to concentrate runoff waters on the lower part. Soils in these positions also receive more water than is normally supplied by precipitation and tend to have a solum like that of the gently sloping soils of lower foot slopes.

In a few areas of the Castle Rock Area small enclosed depressions may trap runoff water to form small intermittent lakes. For some part of the year soil formation in these positions is strongly influenced by excess water that both prevents plant growth and deposits soluble salts and silt.

Parent Material

Differences in physical, chemical, and mineralogical properties of materials have influenced soil formation in the Castle Rock Area. Generally these differences in parent material affect soil properties that are used to classify soils at the series level, but they may also affect properties useful in placing soils in higher categories in the classification system. The properties of the original parent material have controlled the kind of soil formation, as well as the degree of expression of soil horizons.

Parent materials within the Area vary widely in properties, and are discussed in greater detail for each soil series in another section of this survey. For the purpose of illustrating their relationship to soil formation the following general groupings are recognized.

Calcareous fans and pedisediments of Tertiary and Pleistocene age.--These are unconsolidated deposits on large fans and outwash beds at the base of the Rocky Mountains. As used here they include reworked deposits of Younger age that have retained most of the properties of the original deposit. They have hues ranging from 2.5Y to 7.5YR; they contain free calcium carbonate and other water-soluble salts; and they are predominantly moderately coarse textured to moderately fine textured. The sand is mostly quartz, and it ranges mainly from fine to coarse in texture. The major influence of these materials on soil formation and properties is related to age, to particle-size distribution, and to amount of free calcium carbonate and other water-soluble salts.

Noncalcareous, arkosic fans and pedisediments of Tertiary and Pleistocene age.--These are unconsolidated or very weakly consolidated deposits on large fans at the base of the Rocky Mountains. A large part of the material has originated from the weathering of granite bedrock. This group includes reworked deposits of Younger age that have been transported, but that have retained most of the distinguishing properties of the original deposits. They have hues ranging from 5Y to 7.5YR; they contain only small amounts of salts that are readily soluble in water; they have a coarse, moderately coarse, and medium texture; and they contain a large amount of medium and coarse angular fragments of granitic sand and fine pebbles. The major influence of these materials on soil formation and properties is related to the small amount of free calcium carbonate and other readily soluble salts, to the predominantly sandy texture, and to the effect of large amounts of angular sand and fine pebbles.

Red arkose bedrocks of Permian age.--This group of materials includes both residuum weathered from arkose, and transported materials that have retained most of the properties of the original residuum. They have hue ranging from 5YR to 10R; they are noncalcareous; and they have a large amount of medium and coarse angular fragments of granitic pebbles. The major influence of these materials on soil formation and properties is related to the red color, to the lack of free carbonates, and to effect of the amount and coarseness of sand grains.

Gray and olive, calcareous, sedimentary bedrock of Cretaceous age.--This group of materials includes both residuum weathered from sedimentary bedrock and transported materials that have retained most of the properties of the original residuum. They have hue ranging from 5Y to 7.5YR; they contain salts that are readily soluble in water, including salts of sodium; and they usually have a medium, moderately fine, or fine texture. The major influence of these materials on soil formation and properties is related to the amount of water soluble salts of calcium and magnesium, to the presence of sodium salts in some localities, and to the clayey and silty textures.

Red calcareous sedimentary bedrock of Jurassic and Triassic age.--This group of materials includes both residuum weathered from sedimentary bedrock and transported materials that have retained most of the properties of the original residuum. They have hue ranging from 5YR to 10R; they contain salts that are readily soluble in water; they are very easily eroded by water; and they have a medium, moderately fine or fine texture. The major influence of these materials on soil formation and properties is related to the amount of water-soluble salts of calcium and magnesium, to the red color, to the ease with which they erode, and to the clayey and silty textures.

Eolian deposits.--This group of materials includes material accumulated through wind action. These deposits are thin and of local origin. They have hue ranging from 2.5Y to 7.5YR; they contain salts that are readily soluble in water; they have a

very uniform medium to moderately fine texture; and they contain only small amounts of finer or coarser sand. The major influence of these materials on soil formation and properties is related to the amount of water soluble salts of calcium and magnesium, and to their uniform silty texture.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experiences and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (2) and revised later (4). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (3) and was adopted in 1965 (6). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria used as a basis for the classification are soil properties that are observable or measurable. The properties are selected, however; so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 9 shows the classification of each soil series of the Castle Rock Area by family, subgroup, and order, according to the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDERS, SUBORDERS, GREAT GROUPS are subdivisions of groups based on relatively broad sets of differentiating criteria designed principally to bring together soils of similar horizonation, similar genesis, and similar environment. They are not detailed grouping and are most useful in quickly showing general soil differences within the survey, in understanding the basic genetic processes active in the area, and in comparing the overall soil pattern of the survey area with other surveys of the world. Their value for designing specific management practices is limited, but they are useful for county, state, or national planning purposes.

In the following paragraphs each of the four orders represented in the Castle Rock Area, and the suborder and Great Group subdivisions within it, are briefly discussed. It can be seen that as the system proceeds from the order to the Great Group, each grouping of soils that results is narrower in scope and has a higher prediction value for soil use.

Entisols.--These are the soils of the area that are so young that they have not had time to develop distinct genetic horizonation other than a slight darkening of the surface horizon or inconsistent accumulation of soluble salts. There may be considerable physical or chemical difference between strata of these soils, but these differences are not the result of soil development but are characteristics of the parent material as it weathered. Their common characteristic is a lack of distinguishing genetic horizonation.

In the Castle Rock Area the only major subdivision of Entisols that is represented is the Orthents. These are well-drained soils having textures finer than loamy fine sand that lack fragments of horizons in their upper part and have an organic-matter distribution pattern that reaches a maximum in the surface horizons and decreases regularly with depth. The only subdivision of Orthents represented in the Area is the Torriorthents. These are the Orthents of dry areas where supplies of soil moisture are limited.

Aridisols.--The Aridisols are the light-colored soils of arid and semiarid regions that have been in place long enough to have developed distinct genetic horizonation in harmony with the forces of their environment. Although they are primarily grassland soils, the decomposition of organic matter has more or less equalled the yearly additions to the soil. In consequence, they have been unable to develop the dark surface horizons that characterize the Mollisols. In the Castle Rock Area these soils may be associated in the same landscapes with Mollisols, but they generally occupy those portions of the landscape where runoff or texture has proportionally restricted entry of moisture into the soil.

In the Castle Rock Area the major subdivisions of the Aridisols include the Orthids and Argids. Orthids are those Aridisols that have B2 horizons showing some evidence of alteration but not illuviation, or those soils that have duripans or strong accumulation of calcium carbonate, calcium sulfate, or soils more soluble than gypsum. The only subdivision of Orthids represented in the Area is the Camborthids. These are Orthids that have B2 horizons showing evidence of alteration.

The Argids are those Aridisols that have B2 horizons of illuviated silicate clay. The Haplargids, which are the only Argids represented in this survey, have an illuvial B2t horizon of silicate clay that is not saturated with sodium, and that has a gradual increase in clay at its upper boundary. It is not found in conjunction with a duripan or a petrocalcic horizon.

Mollisols.--The Mollisols are soils of humid to subhumid regions that are characterized by thick, dark-colored friable surface horizons in which plentiful supplies of organic matter have accumulated.

TABLE 9.--SOIL SERIES IN THE CASTLE ROCK AREA CLASSIFIED INTO HIGHER CATEGORIES

Series	Current classification system		
	Family	Subgroup	Order
Blakeland	Sandy, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Bresser	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Aridic Argiustolls	Mollisols.
Brussett	Fine-silty, mixed	Aridic Argiborolls	Mollisols.
Buick	Fine-silty, mixed, mesic	Ustollic Haplargids	Aridisols.
Chaseville	Sandy-skeletal, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Cheeseman	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Coni	Loamy, mixed	Lithic Argiborolls	Mollisols.
Crowfoot	Fine-loamy, mixed	Boralfic Argiborolls	Mollisols.
Cruckton	Coarse-loamy, mixed	Aridic Argiborolls	Mollisols.
Denver	Fine, montmorillonitic, mesic	Torrertic Argiustolls	Mollisols.
Englewood	Fine, montmorillonitic, mesic	Torrertic Argiustolls	Mollisols.
Falcon	Loamy, mixed	Lithic Haploborolls	Mollisols.
Fondis	Fine, montmorillonitic, mesic	Aridic Paleustolls	Mollisols.
Garber	Loamy-skeletal, mixed	Pachic Haploborolls	Mollisols.
Gove	Fine-loamy, mixed, mesic	Boralfic Argiustolls	Mollisols.
Heldt	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Jarre	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Juget	Sandy-skeletal, mixed	Lithic Haploborolls	Mollisols.
Kassler	Sandy-skeletal, mixed	Torriorthentic Haploborolls	Mollisols.
Kettle	Fine-loamy, mixed	Psammentic Eutroboralfs	Alfisols.
Kippen	Sandy, mixed	Torriorthentic Haploborolls	Mollisols.
Kutch	Fine, montmorillonitic, mesic	Torrertic Argiustolls	Mollisols.
Larkson	Fine, montmorillonitic	Typic Eutroboralfs	Alfisols.
Lonetree	Sandy, mixed	Torriorthentic Haploborolls	Mollisols.
Louviers	Clayey, montmorillonitic, nonacid, mesic, shallow.	Ustic Torriorthents	Entisols.
Manzanola	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Newlin	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Aridic Argiustolls	Mollisols.
Orsa	Sandy, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Perrypark	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Peyton	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Plome	Fine-loamy, mixed	Typic Eutroboralfs	Alfisols.
Pring	Coarse-loamy, mixed	Aridic Haploborolls	Mollisols.
Razor	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Rednun	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Redridge	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Aridic Argiustolls	Mollisols.
Redtom	Fine-loamy, mixed	Boralfic Argiborolls	Mollisols.
Renohill	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Renohill, reddish variant.	Fine, kaolinitic, mesic	Aridic Argiustolls	Mollisols.
Sampson	Fine-loamy, mixed, mesic	Pachic Argiustolls	Mollisols.
Satanta	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Satanta, calcareous variant.	Fine-loamy, mixed, mesic	Aridic Calciustolls	Mollisols.
Stapleton	Coarse-loamy, mixed, mesic	Aridic Haplustolls	Mollisols.
Tarryall	Fine-loamy, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Tinytown	Coarse-loamy, mixed	Aridic Haploborolls	Mollisols.
Tomah	Fine-loamy, mixed	Boralfic Argiborolls	Mollisols.
Truckton	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Westcreek	Fine-loamy, mixed	Boralfic Argiborolls	Mollisols.

This accumulation is the result of the decomposition in the presence of a predominance of bivalent cations of relatively large yearly return of organic plant materials to the surface horizons either by the fall of plant remains or by decay of the root systems of grasses. Their common characteristic is the darkened, base-enriched surface horizon that soil scientists refer to as a mollic epipedon.

Two subdivisions of Mollisols are represented in the Area. The Ustolls are those Mollisols that are in the warmer parts of the Area generally below elevations of about 7,000 feet. Measured at 20 inches they have mean annual soil temperature warmer than 47° F. The Borolls are those Mollisols that occur in the colder parts of the survey area above 7,000 feet elevation. Their mean annual soil temperature is less than 47° F., but their mean summer soil temperature is warmer than 59° F.

Haplustolls, Calciustolls, Argiustolls, and Paleustolls are all subdivisions of Ustolls represented in the Castle Rock Area. Briefly stated, the Haplustolls are Ustolls that lack horizons of silicate clay accumulation or strong horizons of calcium carbonate accumulation, but usually have horizons showing evidence of alteration. Calciustolls lack silicate clay accumulation but have strong horizons of calcium carbonate accumulation. Argiustolls have horizons of illuvial clay accumulation and gradual clay increase at their upper margin. Paleustolls have horizons of clay accumulation that have abrupt upper boundaries.

In the Castle Rock Area the Borolls may be subdivided into Haploborolls and Argiborolls. The Haploborolls lack horizons of clay accumulation or strong horizons of calcium carbonate accumulation, but they usually have horizons showing evidence of alteration. The Argiborolls have genetic horizons of illuvial clay accumulation.

Alfisols.--The Alfisols are light-colored soils of humid to subhumid areas that have genetic horizons of silicate clay accumulation and are more than 60 percent base saturated. In the Castle Rock Area they are represented by the timbered soils of highest elevation.

The Boralfs are the only subdivision of Alfisols represented in the Area. These are Alfisols having a mean annual soil temperature of less than 47° F.

Eutroborals are the only representatives of the Boralfs present in the survey area. They are Boralfs that have mean summer soil temperatures in excess of 59° F. if they lack O horizons, and which are dry throughout at some time each year.

Subgroups, Families, and Series are the more detailed categories of the taxonomic classification system. The series is the most detailed of these. Differences between units at the series level are drawn on individual soil properties such as color, structure, texture, reaction, and consistence of individual soil horizons. The series provides more information about the soil at a specific location than the subgroup or family and has the greatest value for determining correct use and management of soil.

The Family is a grouping of soil series based primarily on similarities of physical, mineralogical, chemical, and environmental properties. Because the families are groups of series, they are less detailed than the series themselves. Nevertheless, they have considerable value in grouping soils of similar character. Families can be utilized effectively for planning if any one or any combination of factors used to define the families is of prime importance to the uses of the soil being considered.

Like the order, suborder, and Great Groups, the subgroups are a category strongly biased toward soil genesis and environment. Subgroups are the most detailed of the categories having this strong genetic and environmental bias, and are an important category for serious students of soil genesis and classification, as well as being of importance for broad planning of correct soil use.

In the following paragraphs a brief discussion of the major characteristics of each of the subgroups and their subdivision into families are given. The character of each of the individual series is described in another section of this survey and is not repeated here.

Ustic Torriorthents.--These are in semiarid regions where the soil is moist in some part more than one-fourth but less than one-half of the time each year that plants are actively growing. They are limited to fine-textured, noncalcareous soils overlying soft shale at depths of between 10 and 20 inches. Mean annual soil temperature measured above the bedrock is warmer than 47° F. These soils have little or no horizonation other than a slightly darkened A1 horizon.

The Louviers series, which is a member of the clayey, montmorillonitic, nonacid, mesic, shallow family, is the only representative of this subgroup.

Ustertic Carborthids.--These are in semiarid areas where the soil in most years is moist in some part more than one-fourth but less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F.

These soils are limited to fine-textured, calcareous, weakly developed soils that display strong shrink-swell properties. They are characterized by a thin, light-colored A1 horizon and B2 horizon. Weak but continuous horizons of visible secondary calcium carbonate occur above a depth of 40 inches. The clay fraction has more montmorillonite than any other clay mineral. When dry these soils develop large cracks that are generally more than 0.4 inch wide and 12 inches long. They are distinguished by their ability to shrink when dry and swell when moist.

The Heldt series, which is a member of the fine, montmorillonitic, mesic family, is the only representative of this subgroup.

Ustollic Camborthids.--These are in semiarid areas where the soil in most years is moist in some part more than one-fourth but less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F.

These soils are fine-textured, calcareous, and weakly developed. They are characterized by a thin, light-colored A1 horizon and B2 horizon. Weak but continuous horizons of visible secondary calcium carbonate occur above a depth of 40 inches. The clay fraction has more montmorillonite clay than any other clay mineral. The soil does not shrink and swell enough to produce cracks reaching to the soil surface.

Razor soils, a member of the fine, montmorillonite, mesic family, is representative of this subgroup.

Ustollic Haplargids.--These are in semiarid areas where the soil in most years is moist in some part more than one-fourth but less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. This subgroup consists of moderately fine textured to fine textured soils having distinct and continuous genetic horizons of silicate clay accumulation. They are characterized by a thin, light-colored A1 horizon, a B2t horizon of silicate clay accumulation, and weak but continuous horizons of visible secondary calcium carbonate above a depth of 40 inches. Their clay fraction has more montmorillonite than any other clay mineral.

The Buick, Manzanola, and Renohill series are representatives of this subgroup. The Buick series belongs to the fine-silty, mixed, mesic family, and the Manzanola and Renohill series belong to the fine, montmorillonitic, mesic family.

Torriorthentic Haplustolls.--These are in semiarid areas where the soil in most years is moist in some part less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. These soils have a dark-colored, thick, organic-matter enriched A horizon, but they do not have evidence of alteration or eluviation below the A horizon. They are coarse textured to moderately fine textured, and noncalcareous to calcareous.

The Chaseville, Blakeland, Orsa, and Tarryall series are representatives of this subgroup. The Chaseville series, which is a member of the sandy-skeletal, mixed, mesic family, is characterized by having more than 35 percent gravel above a depth of 40 inches. The Blakeland and Orsa series, which are members of the sandy, mixed, mesic family, are similar, but they lack the gravel content of the Chaseville series. The Tarryall series, which is a member of the fine-loamy, mixed, mesic family, differs from the other soils of this subgroup in having finer textures and in being calcareous throughout the profile.

Aridic Haplustolls.--These are in semiarid areas where the soil in most years is dry more than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. These soils have a thick dark-colored A horizon and horizons of alteration above a depth of 40 inches that are distinguished by moderate grades of structure, redder hue, brighter chroma, or lighter value. They are moderately coarse textured, noncalcareous soils that develop from fan deposits of arkose.

The Stapleton series, which is a member of the coarse-loamy, mixed, mesic family, is the only representative of this subgroup.

Aridic Calciustolls.--These are in semiarid areas where the soil is in most years moist less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. These are medium-textured to moderately fine textured, calcareous soils that have strong, continuous horizons of secondary carbonate above a depth of 40 inches. They are characterized by a dark-colored A1 horizon and a very light-colored horizon in which calcium carbonate equivalent exceeds 15 percent.

The Satanta series, calcareous variant, is the only representative of this subgroup. It is a member of the fine-loamy, mixed, mesic family.

Aridic Argiustolls.--These are in semiarid areas where the soil in most years is moist in some part less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. These soils are characterized by moderately dark colored, coarse-loamy to fine-textured soils derived from a variety of parent materials. They have a moderately thick dark-colored A horizon, a B2t horizon of silicate clay accumulation, and where the parent sediments contain free calcium carbonate they have horizons of visible carbonate accumulation below the solum.

The Truckton, Satanta, Bresser, Newlin, Redridge, Rednun, and Renohill, reddish variant, series are representative of this subgroup. The Truckton series, which is a member of the coarse-loamy, mixed, mesic family, has a sandy loam texture and is noncalcareous throughout the profile. The Satanta series, which is a member of the fine-loamy, mixed, mesic family, has a loam or clay loam texture and is noncalcareous in the upper part but becomes calcareous and has distinct horizons of carbonate accumulation above a depth of 40 inches. The Bresser, Newlin, and Redridge series, which are members of the fine-loamy over sandy or sandy-skeletal, mixed, mesic family, have a moderately fine textured B2t horizon, but the solum overlies beds of sand and gravel above a depth of 40 inches. The Rednun series, which is a member of the fine, montmorillonitic, mesic family, has more than 35 percent clay in its B2t horizon and it is noncalcareous in the upper part of the solum but becomes calcareous and has visible secondary carbonate above a depth of 40 inches. The Renohill, reddish variant, series, which is a member of the fine, kaolinitic, mesic family, is noncalcareous, and it is developing in clays in which kaolinite is dominant.

Torrertic Argiustolls.--These are in semiarid areas where the soil in most years is moist in some part less than one-half of the time that plants are actively growing. The mean annual soil temperature is warmer than 47° F. These are soils developing in fine-textured parent sediments and having shrink-swell

properties in their solum and C horizon. They are characterized by a moderately dark colored A1 horizon and fine-textured B2t horizon of silicate clay accumulation. Whey dry, these soils develop side cracks.

The Denver, Englewood, and Kutch series, which are members of the fine, montmorillonitic, mesic family, are all representatives of this subgroup.

Pachic Argiustolls.--These are in subhumid areas where the soil in most years is moist more than one-half of the time that the plants are actively growing. Mean annual soil temperature is warmer than 47° F. These are moderately fine textured soils having very thick, dark-colored horizons extending to a depth of more than 20 inches and having a B2t horizon of silicate clay accumulation. They have weak but continuous horizons of visible secondary carbonate above a depth of 40 inches.

The Sampson series, which is a member of the fine-loamy, mixed, mesic family, is the only representative of this subgroup.

Boralfic Argiustolls.--These are in subhumid areas where the soil in most years is generally moist less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. These are moderately fine textured soils having a moderately thick, dark-colored A1 horizon; a light-colored, eluviated A2 horizon; and an illuvial B2t horizon of silicate clay accumulation. The soils do not have visible accumulation of secondary carbonate or free secondary carbonate above a depth of 40 inches.

The Gove series, which is a member of the fine-loamy, mixed, mesic family, is the only representative of this subgroup.

Aridic Paleustolls.--These are in semiarid areas where the soil in most years is moist in some part less than one-half of the time that plants are actively growing. Mean annual soil temperature is warmer than 47° F. These soils are characterized by a moderately thick, moderately dark colored A1 horizon that rest abruptly on a fine-textured B2t horizon of silicate clay accumulation. These are polygenetic soils in which a modern soil developing in silty eolian materials overlies and merges with an older soil which previously developed in outwash materials. The buried soil in most instances contains visible carbonate accumulation in the cracks between peds and on ped surfaces, but the interiors of peds in these horizons are noncalcareous.

The Fondis series, which is a member of the fine, montmorillonitic, mesic family, is the only representative of this subgroup.

Lithic Haploborolls.--These are in parts of the survey area where the mean annual soil temperature is less than 47° F. and the mean summer soil temperature is more than 59° F. These soils have little horizonation other than a dark-colored surface horizon. They overlie hard bedrock between depths of 10 and 20 inches.

The Juget and Falcon series are representatives of the subgroup. The Juget series, which is a member of the sandy-skeletal, mixed family, is a thin soil developing over granite bedrock. The Falcon series, which is a member of the loamy, mixed family, is a thin soil developing over conglomerate of Tertiary age.

Aridic Haploborolls.--These are at elevations higher than 7,500 feet. The mean annual soil temperature is less than 47° F., and the mean summer soil temperature is warmer than 59° F. These soils are characterized by a moderately dark colored A1 horizon, and a B2 horizon of alteration distinguished by moderate grades of structure, redder hue, brighter chroma, or lighter value. These soils are developing in noncalcareous parent sediments and do not have evidence of translocation of secondary calcium carbonate.

The Pring and Tinytown series are representatives of this subgroup. They belong to the coarse-loamy, mixed family.

Torriorthentic Haploborolls.--These are at high elevations where mean annual soil temperature is less than 47° F., but mean summer soil temperature is more than 59° F. These soils are characterized by a moderately dark colored, moderately thick A horizon that grades to a C horizon that shows little or no alteration. The soils lack visible horizons of secondary carbonate accumulation. The lack of secondary carbonate is not the result of soil genesis but is inherited from the parent sediments.

The Kassler, Kippen, and Lonetree series are representative of this subgroup. The Kippen and Lonetree series are members of the sandy, mixed family. The Kassler series belongs to the sandy-skeletal, mixed family, and has more than 35 percent coarse fragments.

Aridic Pachic Haploborolls.--These are at high elevations where mean annual soil temperature is less than 47° F., but mean summer soil temperature is more than 59° F. These soils are characterized by a very thick, dark-colored, organic-rich A horizon more than 16 inches thick. They generally do not have such horizons locally, and they do not have visible secondary calcium carbonate accumulation. Lack of secondary carbonate is not the result of genesis but is inherited from the parent sediments.

The Garber series, which is a member of the loamy-skeletal, mixed family, is the only representative of this subgroup.

Aridic Lithic Argiborolls.--These are at high elevations where mean annual soil temperature is less than 47° F., and mean summer soil temperature is more than 59° F. These soils are characterized by a moderately dark colored, moderately thick A1 horizon and a thin B2t horizon of silicate clay accumulation. They are thin and overlie bedrock between depths of 10 and 20 inches. Generally the horizons that qualify for a mollic epipedon include both the A and B2t horizons.

The Coni series, which is a member of the loamy, mixed family, is the only representative of this subgroup.

Aridic Argiborolls.--These are in cold, semiarid areas where the soil in most years is moist less than one-half of the time that plants are actively growing. Mean annual soil temperature is less than 47° F., but mean summer soil temperature is more than 59° F. These soils are characterized by a moderately dark colored, moderately thick A1 horizon, and a B2t horizon of silicate clay accumulation. Where the parent sediments contain free calcium carbonate, they have horizons of visible carbonate accumulation below the solum.

The Cruckton, Cheeseman, Jarre, Perrypark, Peyton, and Brussett series are representatives of this subgroup. The Cruckton series, which is a member of the coarse-loamy, mixed family, is sandy loam in texture and noncalcareous throughout the profile. The Cheeseman, Jarre, Perrypark, and Peyton series are members of the fine-loamy, mixed family. They have a B2t horizon of loam, clay loam, or sandy clay loam, and do not have horizons of visible secondary carbonate accumulation. The Brussett series, which is a member of the fine-silty, mixed family, has a B2t horizon of silty clay loam or heavy silt loam containing more than 18 percent clay and less than 15 percent fine or coarser sand. Brussett soils are developing in calcareous eolian sediments and have horizons of visible secondary carbonate accumulation below the solum.

Boralfic Argiborolls.--These are at high elevation where mean annual soil temperature is less than 47° F. and mean summer soil temperature is more than 59° F. These soils are characterized by a moderately thick, moderately dark colored A horizon underlain by a light-colored eluvial A2 horizon that rests upon a B2t horizon of silicate clay accumulation. They are thought to be representative of transitional areas between grassland and forest.

The Crowfoot, Redtom, Tomah, and Westcreek series, which are members of the fine-loamy, mixed family, are representatives of this subgroup.

Typic Eutroboralfs.--These are at high elevations and they are generally associated with relatively open stands of timber. Mean annual soil temperature is less than 47° F., and mean summer soil temperature is more than 59° F. These soils are dry at some season in most every year. They are characterized by a thin, light-colored A1 horizon, a light-colored eluvial A2 horizon, degrading transitional A & B horizons, and a continuous B2t horizon of silicate clay accumulation.

The Plome series, which is a member of the fine-loamy, mixed family, and the Larkson, which is a member of the fine, montmorillonitic family, represent this subgroup.

Psammentic Eutroboralfs.--These are at relatively high elevations under timber cover where mean annual soil temperature is less than 47° F. but mean summer soil temperature is more than 59° F. These soils are dry throughout at some season of most every year. They are characterized by a thin light-colored A1 horizon, a relatively thick light-colored eluvial A2 horizon, and a discontinuous B2t horizon of silicate clay accumulation in which the clay is accumulating in bands and streaks within a much coarser matrix.

The Kettle series, which is a member of the fine-loamy, mixed family, is the only representative of this subgroup.

GENERAL NATURE OF THE AREA

The Castle Rock Survey Area is that part of Douglas County excluding the area in Pike National Forest and one large ranch on the northern boundary at the request of the owner. The County was established in 1861 (1) by the Territorial Assembly for Colorado and named for U.S. Senator Stephen A. Douglas. Franktown, settled in 1860, was selected as the temporary county seat. In 1874 the county seat was moved to Castle Rock, where it remains today. In 1870, the Kansas Pacific Railroad completed its line through the county enroute from Kansas City to Denver. This railroad was followed by the Denver and Rio Grande and the Santa Fe Railroads that are still operating.

Other settlements followed; among them was Larkspur, which was a stage stop, Sedalia, and Greenland, all in 1875. The Greenland area was considered a fine potato growing area. Today potato growing is nonexistent.

Sawmills were erected in the pine forests during this time, and lumbering became an important industry. The cutting of original stands of trees was largely completed by 1915. The present woods are practically all second growth. Only a few portable sawmills exist today.

The population of the county is increasing, partly because of the expanding economy in nearby metropolitan areas. The population in 1900 was 3,120; in 1940, 3,496; in 1960, 4,816; and in 1970 it was 8,407. Castle Rock had a population of 1,531 in 1970.

Most of the agriculture in the Castle Rock Area is centered around livestock production. About 85 percent of the Area is range and is used for grazing cattle, mainly feeder cattle, but also some purebred breeding and dairy herds.

The number of livestock has remained fairly constant throughout the years. In 1964, livestock numbered about 23,650. The number of dairy cattle decreased to about 1,800 in 1964. Hogs and poultry are of minor number.

About 10 percent of the Area is dryland farmed, and about 5 percent is irrigated crop and hay land. Wheat is the main crop, but acres planted decreased slightly to 7,479 in 1964. The decrease is partly the result of wheat allotments, and partly the

result of reseeding to grass, especially in the southern part of the Area. Alfalfa is the second main crop; 5,165 acres was in alfalfa in 1964. Wild hay, oats, corn, and barley fluctuate from year to year. The acreage has ranged from about 2,000 to 4,500 acres since 1945. Some small grains are grown, mostly as a cover crop.

Climate [9/]

The climate of the Castle Rock Area is of the high inland continental type, as modified by the presence of the Rocky Mountains rising immediately to the west, Palmer Lake Divide along the southern border, and by local variations of topography within the Area. General climatic characteristics of the Area include generally low precipitation, low average humidity, variable windiness, and a fairly wide temperature range.

Precipitation in the Area is light because of the long distance from major sources of moisture. Air coming into the Area with the prevailing winds from the west has lost most of its moisture in passage over the high mountains and contributes only a small part of the precipitation of areas east of the mountains. Most of the precipitation in the Area comes from moisture brought in from the east when changes in the general circulation pattern interrupt the westerlies from time to time. This occurs most often in the spring and into the early fall and least often in the winter months. As a result, winter is the driest part of the year, with an average of 8 to 9 percent of the yearly total occurring in December through February. About one-third of the total falls in the seven months September through March, and about two-thirds in the five months from April through August. May, usually the wettest month of the year, receives about 16 to 20 percent of the yearly total.

Average annual precipitation in the Area varies from nearly 15 inches to more than 18 inches. Higher precipitation occurs at higher elevations and along the western border of the Area. Totals for individual years vary within a wide range, or from 7 inches or less to more than 20 inches in the drier areas, and from 10 inches to nearly 30 inches in the wetter areas. Variations are rather wide within the same year for different parts of the Area because a large part of the yearly total is from summer thunderstorms that often cover a relatively small area with heavy precipitation and leave nearby areas with little or none. Table 10 gives some comparative precipitation data for locations within or just outside the borders of the Castle Rock Area.

There are no long-period temperature records available for locations within the Castle Rock Area, so that averages given in table 11 are from stations near the Castle Rock Area. The averages for these stations are considered representative of parts of the Area that are of intermediate elevation. A short record of temperatures at Castle Rock indicate that minimum temperatures average two to three degrees cooler in the summer and up to one degree cooler in the winter than those for Parker 9E. Maximum temperatures average slightly warmer at Castle Rock, but the difference is generally less than a half degree. Extreme minimum temperatures range in the Area from about -30° F. in the lower elevations to -40° F. at higher elevations. Monthly minimums reach as low as 32° F. or lower for all months except July and August at the lower and warmer locations. Extreme maximum temperatures run to slightly more than 100° F. throughout the area. Monthly extreme maximums are 70° F. or higher for all months of the year, except at the higher elevations, where they are slightly below 70° F. in the winter months. Table 12 shows the probabilities of temperatures of 32° F. and 28° F. for specified dates in spring and fall for the northern and southern part of the Area.

9/ J. W. BERRY, climatologist for Colorado, National Weather Service, U.S. Department of Commerce, helped prepare this section.

TABLE 10.--PRECIPITATION DATA FOR THE CASTLE ROCK AREA

Station and elevation	Period	Average annual	Greatest annual		Least annual		Maximum monthly	Average number of days with precipitation--	
			Total	Year	Total	Year		0.10 in.	0.50 in.
		In.	In.		In.		In.		
Castle Rock----- (6,205 feet)	1941-63	14.56	20.75	1941	10.73	1962	4.00	--	--
Cherry Creek Dam---------- (5,649 feet)	1952-63	13.70	20.55	1957	6.79	1954	6.96	35	6
Greenland 8SE--- (7,350 feet)	1941-63	17.80	26.25	1957	11.63	1954	5.15	--	--
Greenland 9NE--- (6,725 feet)	1945-63	15.00	21.30	1957	9.46	1950	6.04	--	--
Kassler--------- (5,496 feet)	1931-60	17.41	25.95	1942	10.71	1956	9.14	39	11
Monument 2W----- (7,400 feet)	1931-60	18.55	29.93	1957	9.67	1939	8.63	51	9
Parker 9E-------	1931-60	13.41	20.60	1941	6.99	1954	5.75	35	6

TABLE 11.--TEMPERATURE DATA FOR THE CASTLE ROCK AREA

Station and elevation	Annual average daily maximum	Annual average daily minimum	Average number of days with--		Record maximum	Record minimum
			Maximum temperature of 90° or more	Minimum temperature of 32° or less		
	°F.	°F.			°F.	°F.
Kassler---------- (5,496 feet)	66.6	36.8	39	145	103	-32
Cherry Creek Dam--- (5,649 feet)	65.6	34.5	33	170	102	-32
Parker 9E---------- (6,300 feet)	63.4	30.9	34	184	103	-38
Monument 2w-------- (7,400 feet)	60.3	30.8	15	187	100	-40

TABLE 12.--PROBABILITY OF SPECIFIED TEMPERATURES IN SPRING AND FALL

Temperature and location	Probability	Spring	Fall	Number of days between dates
32° F.				
Northern part of the Area	1 year in 10	June 11	September 9	89
	2 years in 10	June 5	September 14	100
	5 years in 10	May 24	September 24	122
Southern part of the Area	1 year in 10	June 12	September 8	87
	2 years in 10	June 6	September 13	98
	5 years in 10	May 25	September 23	120
28° F.				
Northern part of the Area	1 year in 10	May 31	September 21	112
	2 years in 10	May 25	September 26	123
	5 years in 10	May 13	October 5	143
Southern part of the Area	1 year in 10	May 31	September 16	107
	2 years in 10	May 25	September 21	118
	5 years in 10	May 14	October 1	137

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GLOSSARY

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Arkose. A sandstone derived from disintegrated granite or gneiss and characterized by fragments of feldspar. An arkosic conglomerate is one in which the fine material, or matrix containing the boulders or pebbles, is arkose.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available moisture (or water) capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Chiseling. Tillage with a machine that has one or more soil-penetrating points that can be drawn through the soil to loosen the subsoil, generally to a depth of 12 to 18 inches. This machine is used for emergency tillage; the clods it brings to the soil surface deflect erosive wind.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are--

Loose.--Noncoherent when dry or moist; does not hold together in a mass.

Friable.--When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.--When moist, crushed under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.--When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.--When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.--When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.--When dry, breaks into powder or individual grains under very slight pressure.

Cemented.--Hard and brittle; little affected by moistening.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparision with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.--Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are--

Border.--Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.--Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.--Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.--Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.--Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.--Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.--Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.--Irrigation water, released at high points, flows onto the field without controlled distribution.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Miscellaneous land type. A mapping unit for areas of land that have little or no natural soil; or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance--few, common, and many; size--fine, medium, and coarse; and contrast--faint, distinct, and prominent. The size measurements are these: fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables--hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below a depth of 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Ped. An individual natural soil aggregate.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range condition. The state of health or productivity of both soil and forage in a given range, in terms of what productivity could or should be under normal climate and the best practical management. Condition classes generally recognized are--excellent, good, fair, and poor. The classification is based on the percentage of original, or climax, vegetation on the site, as compared to what ought to grow on it if management were good.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rotation grazing. Grazing two or more pastures, or parts of a range, in regular order, with definite recovery periods between grazing periods. Contrasts with continuous grazing.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: Very coarse sand (2.0 to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.05 to 0.002 millimeter); and clay (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are--platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introduction to the section it is in for general information about its management.

Acreage and extent, table 1, pg. 6.
Estimated yields, table 2, pg. 55.
Limitations of soils for recreational uses, table 3, pg. 60.
Wildlife, table 4, pg. 62.

Engineering uses of the soils, tables 5, 6, and 7, pp. 66 through 91.
Limitations of soils for town and country planning, table 8, pg. 94.

Map symbol	Mapping unit	Described on page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site: Name	Range site Page
BlE	Blakeland sandy loam, 1 to 15 percent slopes	7	VIe-3	53	None	--	Sandy Foothill	58
Bo	Blakeland-Orsa association	7	IVe-5	51	IVs-1	51	Sandy Foothill	58
BrB	Bresser sandy loam, 1 to 3 percent slopes	8	IIIe-1	49	IIe-2	49	Sandy Foothill	58
BrD	Bresser sandy loam, 3 to 9 percent slopes	8	IVe-4	51	IVe-2	50	Sandy Foothill	58
BsE	Bresser-Louviers complex, 7 to 30 percent slopes	8						
	Bresser	--	VIe-2	52	None	--	Sandy Foothill	58
	Louviers	--	VIe-2	52	None	--	Clayey Foothill	55
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	9	VIe-2	52	None	--	Sandy Foothill	58
BuD2	Bresser and Truckton soils, 3 to 12 percent slopes, eroded	9	VIe-2	52	None	--	Sandy Foothill	58
BvB	Brussett loam, 1 to 3 percent slopes	10	IIIc-1	50	None	--	Loamy Park	57
BvD	Brussett loam, 3 to 9 percent slopes	10	IVe-3	50	None	--	Loamy Park	57
BwD	Buick-Satanta loams, 3 to 9 percent slopes	11	IVe-3	50	IVe-1	50	Loamy Foothill	56
CoG	Coni rocky loam, 3 to 100 percent slopes	12	VIIe-1	53	None	--	Loamy Park	57
CrE	Crowfoot-Tomah sandy loams, 5 to 25 percent slopes	13	VIe-3	53	None	--	Sandy Divide	58
CsD	Cruckton sandy loam, 1 to 9 percent slopes	14	IVe-3	50	None	--	Sandy Divide	58
CtE	Cruckton-Peyton sandy loams, 7 to 20 percent slopes	14	VIe-3	53	None	--	Sandy Divide	58
DeD	Denver clay loam, 5 to 12 percent slopes	15	VIe-1	52	None	--	Clayey Foothill	55
En	Englewood clay loam	16	IVs-2	52	IIIs-1	49	Clayey Foothill	55
FoB	Fondis clay loam, 1 to 3 percent slopes	17	IIIc-1	50	IIe-1	49	Clayey Foothill	55
FoD	Fondis clay loam, 3 to 9 percent slopes	17	IVe-3	50	IVe-1	50	Clayey Foothill	55
Fu	Fondis-Kutch association	18						
	Fondis	--	VIe-1	52	None	--	Loamy Foothill	56
	Kutch	--	VIe-1	52	None	--	Clayey Foothill	55
GaE	Garber gravelly sandy loam, 5 to 30 percent slopes	18	VIe-4	53	None	--	Loamy Park	57
GoE	Gove sandy loam, 5 to 20 percent slopes	19	VIe-3	53	None	--	Sandy Foothill	58
GsF	Gove-Shale outcrop complex, 5 to 65 percent slopes	19						
	Gove	--	VIe-2	52	None	--	Sandy Foothill	58
	Shale outcrop	--	VIe-2	52	None	--	None	--
He	Heldt clay	20	VIe-1	52	None	--	Clayey Foothill	55
Hg	Hilly gravelly land	20	VIIs-1	54	None	--	Cobbly Foothill	56
Jb	Jarre-Brussett association	21	VIe-3	53	None	--	Loamy Park	57
JuF	Juget rocky complex, 20 to 65 percent slopes	21	VIIe-2	54	None	--	Stony Loam	58
JvF	Juget very rocky complex, 20 to 65 percent slopes	22	VIIe-2	54	None	--	None	--
Ka	Kassler gravelly sandy loam	22	VIe-4	53	IVs-1	51	Loamy Park	57
KeE	Kettle loamy sand, 5 to 25 percent slopes	23	VIe-5	53	None	--	None	--
KfF	Kettle-Falcon complex, 9 to 65 percent slopes	23	VIIe-2	54	None	--	None	--
KnE	Kippen loamy sand, 1 to 20 percent slopes	24	VIe-4	53	None	--	Sandy Divide	58
KpD2	Kippen and Pring soils, 1 to 12 percent slopes, eroded	24	VIe-4	53	None	--	Sandy Divide	58
KtE	Kutch sandy loam, 5 to 20 percent slopes	25	VIe-1	52	None	--	Sandy Foothill	58

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GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site: Name	Range site Page
KuD	Kutch clay loam, 4 to 8 percent slopes	25	IVe-3	50	None	--	Clayey Foothill	55
KuE	Kutch clay loam, 8 to 20 percent slopes	25	VIe-1	52	None	--	Clayey Foothill	55
KwF	Kutch-Newlin-Stapleton complex, 8 to 40 percent slopes	25	VIe-5	53	None	--	None	--
LaD	Larkson fine sandy loam, 3 to 9 percent slopes	26	VIe-5	53	None	--	None	--
Lo	Loamy alluvial land	26	VIw-1	53	None	--	Overflow	57
Lu	Loamy alluvial land, dark surface	26	IVw-1	51	None	--	Loamy Foothill	56
Lw	Loamy wet alluvial land	27	Vw-1	52	None	--	Mountain Meadow	57
Ma	Manzanola clay loam	28	IVe-3	50	None	--	Clayey Foothill	55
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	29	VIe-2	52	None	--	Gravelly Foothill	56
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	29						
	Newlin	--	VIe-2	52	None	--	Gravelly Foothill	56
	Satanta	--	VIe-2	52	None	--	Loamy Foothill	56
PdE	Perrypark sandy loam, 3 to 20 percent slopes	31	VIe-3	53	None	--	Sandy Divide	58
PeB	Peyton sandy loam, 1 to 3 percent slopes	31	IIIc-1	50	None	--	Sandy Divide	58
PeD	Peyton sandy loam, 3 to 9 percent slopes	31	IVe-3	50	None	--	Sandy Divide	58
PfC	Peyton sandy loam, wet, 1 to 5 percent slopes	32	IVw-1	51	None	--	Sandy Divide	58
PpE	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes	32						
	Peyton	--	VIe-3	53	None	--	Sandy Divide	58
	Pring	--	VIe-3	53	None	--	Loamy Park	57
	Crowfoot	--	VIe-3	53	None	--	Sandy Divide	58
PrE2	Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded	32	VIe-3	53	None	--	Sandy Divide	58
PsE	Plome loamy sand, 5 to 25 percent slopes	33	VIe-5	53	None	--	None	--
PvE	Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes	34						
	Pring	--	VIe-3	53	None	--	Loamy Park	57
	Kippen	--	VIe-3	53	None	--	Sandy Divide	58
RaE	Razor clay, 3 to 25 percent slopes	34	VIe-1	52	None	--	Clayey Foothill	55
RdD	Rednun loam, 3 to 10 percent slopes	35	IVe-3	50	None	--	Loamy Foothill	56
ReE	Rednun-Redridge complex, 8 to 40 percent slopes	35						
	Rednun	--	VIe-1	52	None	--	Loamy Foothill	56
	Redridge	--	VIe-1	52	None	--	Gravelly Foothill	56
RgF	Redridge-Chaseville gravelly sandy loams, 10 to 70 percent slopes	36	VIe-2	52	None	--	Gravelly Foothill	56
RlE	Redtom-Lonetree complex, 5 to 25 percent slopes	37	VIe-4	53	None	--	Sandy Divide	58
RmE	Renohill-Buick complex, 5 to 25 percent slopes	37						
	Renohill	--	VIe-1	52	None	--	Clayey Foothill	55
	Buick	--	VIe-1	52	None	--	Loamy Foothill	56
RnE	Renohill-Manzanola clay loams, 3 to 20 percent slopes	37	VIe-1	52	None	--	Clayey Foothill	55
RoE	Renohill sandy loam, reddish variant, 5 to 20 percent slopes	38	VIe-1	52	None	--	Sandy Foothill	58
RtG	Rock land-Lonetree complex, 10 to 100 percent slopes	38						
	Rock land	--	VIIe-1	53	None	--	None	--
	Lonetree soils	--	VIIe-1	53	None	--	Shallow Foothill	58
Sa	Sampson loam	39	IIIc-1	50	IIe-1	49	Loamy Foothill	56
Sd	Sandy alluvial land	39	VIIw-1	54	None	--	None	--
Se	Sandy wet alluvial land	39	VIIw-1	54	None	--	None	--
Sn	Satanta loam	40	IIIc-1	50	IIe-1	49	Loamy Foothill	56
SrD	Satanta loam, calcareous variant, 3 to 9 percent slopes	41	IVe-3	50	IVe-1	50	Loamy Foothill	56
SrE	Satanta loam, calcareous variant, 9 to 25 percent slopes	41	VIe-3	53	None	--	Loamy Foothill	56

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site: Name	Range site Page
SsE	Stapleton loamy sand, 6 to 30 percent slopes	42	VIe-5	53	None	--	None	--
St	Stapleton-Bresser association	42	VIe-2	52	None	--	Sandy Foothill	58
Su	Stony rough land	42	VIIs-1	54	None	--	Stony Loam	58
Sv	Stony steep land	42	VIIs-1	54	None	--	Rocky Foothill	57
Sw	Stony steep land, cold	42	VIIs-1	54	None	--	Stony Loam	58
TaF	Tarryall gravelly loam, 10 to 50 percent slopes	43	VIIe-1	53	None	--	Shallow Foothill	58
TcE	Tinytown-Cheeseman complex, 5 to 30 percent slopes	44	VIe-3	53	None	--	Loamy Park	57
TrB	Truckton sandy loam, 1 to 3 percent slopes	45	IIIe-1	49	IIe-2	49	Sandy Foothill	58
TrD	Truckton sandy loam, 3 to 8 percent slopes	45	IVe-4	51	IVe-2	50	Sandy Foothill	58
WeE	Westcreek gravelly loam, 10 to 30 percent slopes	46	VIe-3	53	None	--	Loamy Park	57

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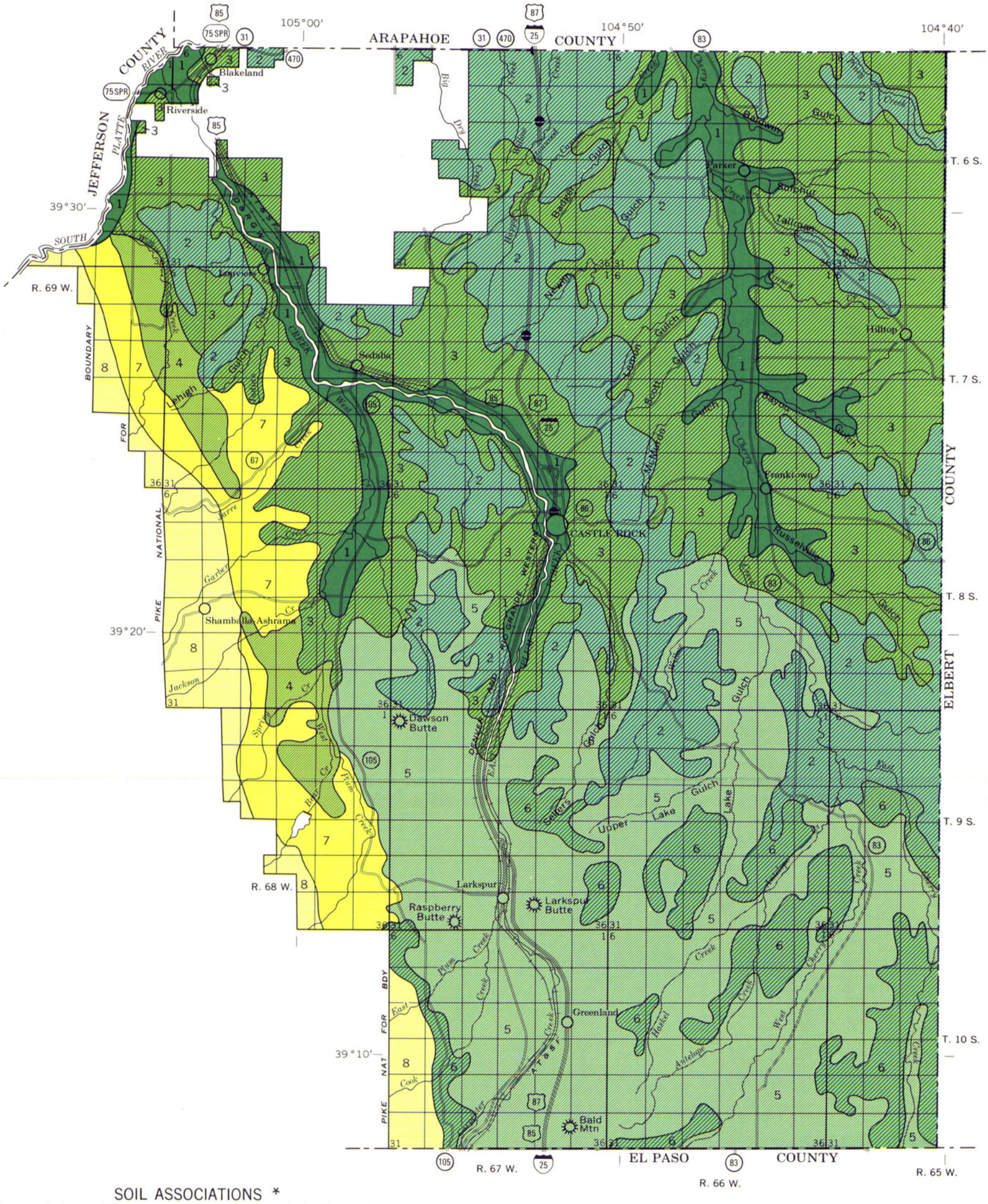


SOIL ASSOCIATIONS *

1. Loamy alluvial land-Sampson association: Deep, nearly level to gently sloping, loamy and sandy soils on flood plains and terraces
2. Fondis-Kutch association: Deep and moderately deep, gently sloping to moderately steep, loamy soils on uplands
3. Bresser-Newlin-Stapleton association: Deep, gently sloping to moderately steep, sandy and gravelly soils on uplands
4. Razor-Denver association: Deep and moderately deep, gently sloping to steep, clayey soils on uplands
5. Peyton-Kettle-Crowfoot association: Deep, gently sloping to moderately steep, sandy soils on uplands
6. Brussett-Jarre association: Deep, gently sloping to steep, loamy soils on tablelands
7. Garber-Kassler-Rockland association: Deep to shallow, gently sloping to steep, sandy and gravelly soils on terraces, fans, and valley side slopes
8. Juget-Rock land association: Shallow, steep, gravelly soils and Rock land in mountainous areas

* Texture in the name of the associations refers to the surface layer of the major soils.

Compiled 1973

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

COLORADO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

CASTLE ROCK AREA, DOUGLAS COUNTY, COLORADO

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS

CASTLE ROCK AREA, DOUGLAS COUNTY, COLORADO

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit (G.P.)

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds (water, w)
- Perennial
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

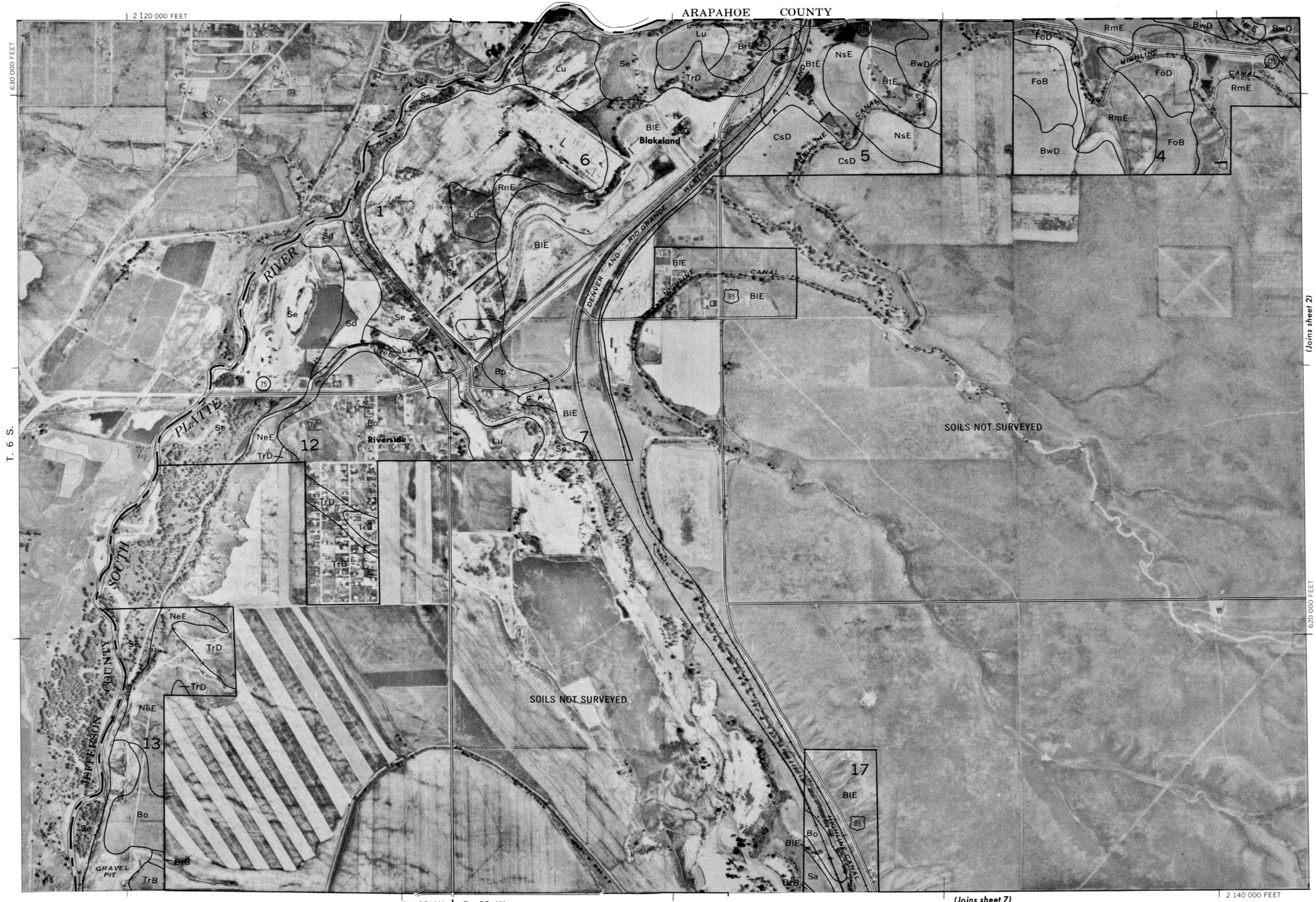
- Soil boundary and symbol (Dx)
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Saline spot
- Gypsum bed

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, B, C, D, E, F, or G, shows the slope. Most symbols without a slope letter are those of nearly level soils but some are for soils that have a considerable range of slope. A final number, 2, in the symbol shows that the soil is eroded.

SYMBOL	NAME
BIE	Blakeland sandy loam, 1 to 15 percent slopes
Bo	Blakeland-Orsa association
BrB	Bresser sandy loam, 1 to 3 percent slopes
BrD	Bresser sandy loam, 3 to 9 percent slopes
BsE	Bresser-Louviers complex, 7 to 30 percent slopes
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes
BuD2	Bresser and Truckton soils, 3 to 12 percent slopes, eroded
BvB	Brussett loam, 1 to 3 percent slopes
BvD	Brussett loam, 3 to 9 percent slopes
BwD	Buick-Satanta loams, 3 to 9 percent slopes
CoG	Coni rocky loam, 3 to 100 percent slopes
CrE	Crowfoot-Tomah sandy loams, 5 to 25 percent slopes
CsD	Cruckton sandy loam, 1 to 9 percent slopes
CtE	Cruckton-Peyton sandy loams, 7 to 20 percent slopes
DeD	Denver clay loam, 5 to 12 percent slopes
En	Englewood clay loam
FoB	Fondis clay loam, 1 to 3 percent slopes
FoD	Fondis clay loam, 3 to 9 percent slopes
Fu	Fondis-Kutch association
GaE	Garber gravelly sandy loam, 5 to 30 percent slopes
GoE	Gove sandy loam, 5 to 20 percent slopes
GsF	Gove-Shale outcrop complex, 5 to 65 percent slopes
He	Heldt clay
Hg	Hilly gravelly land
Jb	Jarre-Brussett association
JuF	Juget rocky complex, 20 to 65 percent slopes
JvF	Juget very rocky complex, 20 to 65 percent slopes
Ka	Kassler gravelly sandy loam
KeE	Kettle loamy sand, 5 to 25 percent slopes
KfF	Kettle-Falcon complex, 9 to 65 percent slopes
KnE	Kippen loamy sand, 1 to 20 percent slopes
KpD2	Kippen and Pring soils, 1 to 12 percent slopes, eroded
KtE	Kutch sandy loam, 5 to 20 percent slopes
KuD	Kutch clay loam, 4 to 8 percent slopes
KuE	Kutch clay loam, 8 to 20 percent slopes
KwF	Kutch-Newlin-Stapleton complex, 8 to 40 percent slopes
LaD	Larkson fine sandy loam, 3 to 9 percent slopes
Lo	Loamy alluvial land
Lu	Loamy alluvial land, dark surface
Lw	Loamy wet alluvial land
Ma	Manzanola clay loam
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes
NsE	Newlin-Satanta complex, 5 to 20 percent slopes
PdE	Perrypark sandy loam, 3 to 20 percent slopes
PeB	Peyton sandy loam, 1 to 3 percent slopes
PeD	Peyton sandy loam, 3 to 9 percent slopes
PfC	Peyton sandy loam, wet, 1 to 5 percent slopes
PpE	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes
PrE2	Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded
PsE	Plome loamy sand, 5 to 25 percent slopes
PvE	Pring and Kippen gravelly sandy loams, 1 to 25 percent slopes
RaE	Razor clay, 3 to 25 percent slopes
RdD	Rednun loam, 3 to 10 percent slopes
ReE	Rednun-Redridge complex, 8 to 40 percent slopes
RgF	Redridge-Chaseville gravelly sandy loams, 10 to 70 percent slopes
RlE	Redtom-Lonetree complex, 5 to 25 percent slopes
RmE	Renohill-Buick complex, 5 to 25 percent slopes
RnE	Renohill-Manzanola clay loams, 3 to 20 percent slopes
RoE	Renohill sandy loam, reddish variant, 5 to 20 percent slopes
RtG	Rock land-Lonetree complex, 10 to 100 percent slopes
Sa	Sampson loam
Sd	Sandy alluvial land
Se	Sandy wet alluvial land
Sn	Satanta loam
SrD	Satanta loam, calcareous variant, 3 to 9 percent slopes
SrE	Satanta loam, calcareous variant, 9 to 25 percent slopes
SsE	Stapleton loamy sand, 6 to 30 percent slopes
St	Stapleton-Bresser association
Su	Stony rough land
Sv	Stony steep land
Sw	Stony steep land, cold
TaF	Tarryall gravelly loam, 10 to 50 percent slopes
TcE	Tinytown-Cheeseman complex, 5 to 30 percent slopes
TrB	Truckton sandy loam, 1 to 3 percent slopes
TrD	Truckton sandy loam, 3 to 8 percent slopes
WeE	Westcreek gravelly loam, 10 to 30 percent slopes

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 1



N

1 Mile
5000 Feet

Scale 1:20000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station. Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum. Land division corners are approximately positioned on this map.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 2

N

1 Mile
5000 Feet

Scale 1:20000

R. 68 W. | R. 67 W. ARAPAHOE COUNTY

2 165 000 FEET

630 000 FEET

T. 6 S.

620 000 FEET

2 145 000 FEET

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 8)

SOILS NOT SURVEYED

SOILS NOT SURVEYED

SOILS NOT SURVEYED

SOILS NOT SURVEYED

SOIL SURVEY LIMIT OF

Big Dry Creek

6

FoD
RmE
FoD
RmE
FoD
RmE
NeE
RmE
FoD
RmE
FoD

17

FoD
RmE
RmE
RnE
RmE
FoD
FoD
RmE

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

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CASTLE ROCK AREA, COLORADO NO. 2

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 3

ARAPAHOE COUNTY

2 170 000 FEET

630 000 FEET

T. 6 S.

SOILS NOT SURVEYED

Willow Creek

Cook Creek

Big Dry Cr

Cottonwood Creek

Lo Creek Canyon

Happy Gulch

Badger

(Joins sheet 2)

(Joins sheet 9)

(Joins sheet 4)

R. 67 W.

2 185 000 FEET

620 000 FEET

3

N

1 Mile

5000 Feet

Scale 1:20000

N

ARAPAHOE COUNTY

2 210 000 FEET

630 000 FEET

T. 6 S.

1 Mile

5000 Feet

0

0

Scale 1:20000

(Joins sheet 3)

1 000

¼

2000

½

3000

¾

4000

1

5000

620 000 FEET

2 190 000 FEET

R. 66 W.

(Joins sheet 5)

(Joins sheet 10)

Grandview Estates

Cherry Creek

Happy Canyon

Baldwin Gulch

Newlin Gulch

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

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CASTLE ROCK AREA, COLORADO NO. 4

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 5

ARAPAHOE COUNTY

2 215 000 FEET

630 000 FEET

T. 6 S.

ELBERT COUNTY

620 000 FEET

(Joins sheet 4)

(Joins sheet 11)

2 235 000 FEET

R. 66 W. | R. 65 W.

N

Scale 1:20000

1 Mile

5000 Feet

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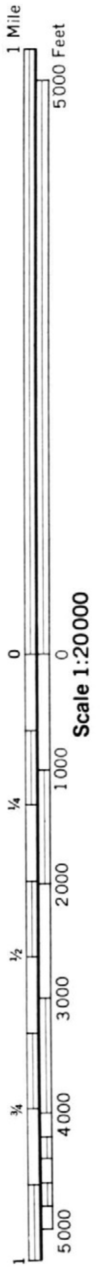
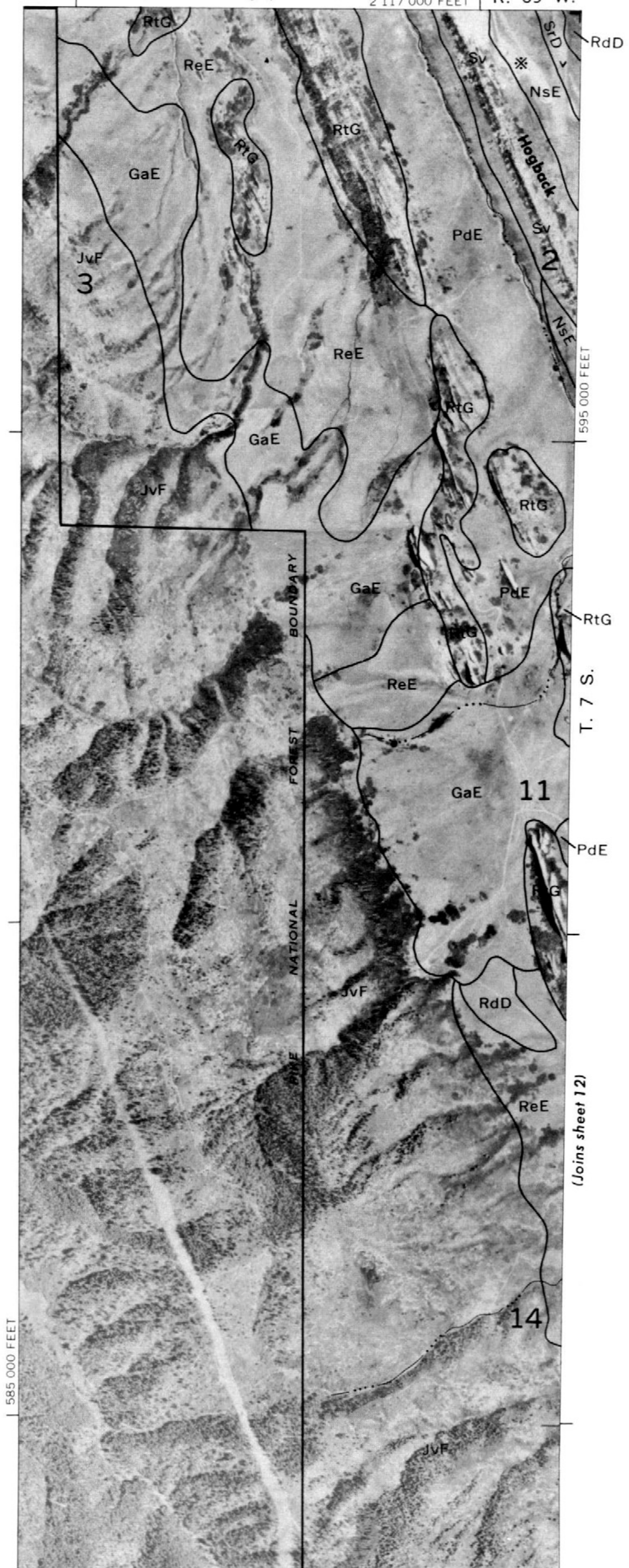
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

N





Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

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Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

7

N

2 120 000 FEET

615 000 FEET

R. 69 W. | R. 68 W.

(Joins sheet 1)

T. 6 S.

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

2 140 000 FEET

600 000 FEET

SOILS NOT SURVEYED

Scale 1:20000

1 Mile

5000 Feet

N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 2)

2 165 000 FEET

615 000 FEET

RnE

Ma

RmE

20

SOILS NOT SURVEYED

T. 6 S.

(Joins sheet 7)

(Joins sheet 9)

600 000 FEET

Fu

FoD

BsE

Lo

34

En

Bo

Kellytown

Sa

NsE

NeE

Hg

Sv

CoG

31

32

FoB

(Joins sheet 13)

2 145 000 FEET

R. 68 W. | R. 67 W.

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 6

CASTLE ROCK AREA, COLORADO NO. 9

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

(Joins sheet 3)

2 170 000 FEET

R. 67 W.

615 000 FEET

T. 6 S.

SOILS NOT SURVEYED

Cottonwood Ct.

Happy Canyon

Big Dry Creek

Badger Gulch

Canyon Creek

Happy Sa

Newlin Gulch

20 21 22 23 24 25 26 27 28 32 33 34 35 36

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 14)

2 185 000 FEET

600 000 FEET

9

N

1 Mile

5000 Feet

Scale 1:20000

N

R. 66 W.

T. 6 S.

2 210 000 FEET

615 000 FEET

600 000 FEET

2 190 000 FEET

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 15)

1 Mile 5000 Feet

0 0

Scale 1:20000

1000 2000 3000 4000 5000

¼ ½ ¾ 1

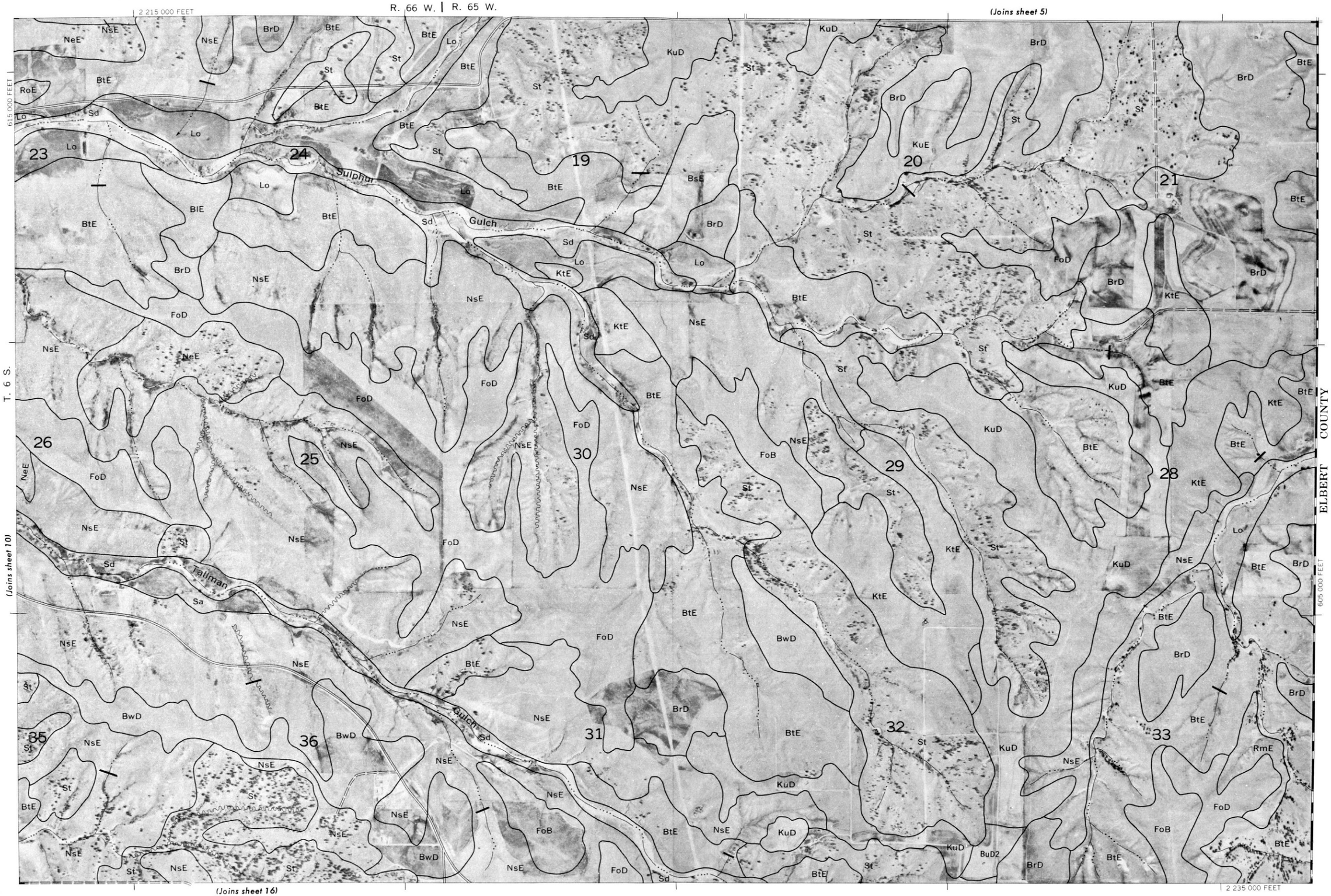
Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 11

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.



ELBERT COUNTY

N

1 Mile
5000 Feet

Scale 1:20000

N

R. 69 W. | R. 68 W.

(Joins sheet 7)

2 140 000 FEET

595 000 FEET

T. 7 S.

(Joins sheet 13)

2 120 000 FEET

(Joins sheet 17)

585 000 FEET

1 Mile

5000 Feet

Scale 1:20000

(Joins inset, sheet 6)

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 13

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

2 145 000 FEET

595 000 FEET

T. 7 S.

(Joins sheet 8)

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 18)

2 165 000 FEET

585 000 FEET

R. 68 W. | R. 67 W.

PLUM CREEK

DENVER AND RIO GRANDE WESTERN

ATCHISON TOPEKA AND SANTA FE

Sedalia

Cherokee Mountain

Raccoon Knob

N

1 Mile

5000 Feet

Scale 1:20000

N

R. 67 W.

(Joins sheet 9)

2 185 000 FEET

595 000 FEET

T. 7 S.

(Joins sheet 15)

585 000 FEET

2 170 000 FEET

(Joins sheet 19)

(Joins sheet 13)

1 Mile — 5000 Feet

Scale 1:20000

0 — 0

1/4 — 1 000

1/2 — 2000

3/4 — 3000

1 — 4000 — 5000

Beverly Hills

Hanna Canyon Creek

Newlin Gulch

South Newlin Gulch

Sa

Sd

Lo

NsE

Fu

FoD

Hg

BtE

CoG

KtE

KwF

Sv

St

Bo

5 4 3 2 1

8 9 10 11 12

17 16 15 14 13

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 14

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 15

15

CASTLE ROCK AREA, COLORADO NO. 15

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

2 190 000 FEET

(Joins sheet 10)

R. 66 W

595 000 FEET

T. 7 S.

(Joins sheet 14)

(Joins sheet 20)

2 210 000 FEET

(Joins sheet 16)

585 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

Kinney Gulch

Kinney Creek

Lemon Gulch

Cherry Creek

Scott Gulch

Lemon Gulch

FONDER CEMETERY

CLAY PIT

16

N

R. 66 W. | R. 65 W.

(Joins sheet 11)

2 235 000 FEET

600 000 FEET

1 Mile

5000 Feet

0 1:20000 0

Scale 1:20000
(Joins sheet 15)

¼ 1000

½ 2000

¾ 3000

1 4000

5000

Tallman Gulch

Kinney Creek

Moonshine Gulch

Hilltop

Coal Creek

ELBERT COUNTY

T. 7 S.

585 000 FEET

2 215 000 FEET

(Joins sheet 21)

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 16

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 17

17

N

R. 69 W | R. 68 W.

(Joins sheet 12)

2 120 000 FEET

580 000 FEET

(Joins inset, sheet 22)

T. 7 S.

(Joins sheet 18)

570 000 FEET

2 140 000 FEET

(Joins sheet 22)

1 Mile

5000 Feet

Scale 1:20000

CASTLE ROCK AREA, COLORADO NO. 17

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

N

1 Mile

5000 Feet

0

Scale 1:20000

(Joins sheet 17)

(Joins sheet 13)

R. 68 W. | R. 67 W.

Hg

2 165 000 FEET

580 000 FEET

T. 7 S.

(Joins sheet 19)

1 570 000 FEET

2 145 000 FEET

(Joins sheet 23)

PLUM CREEK

EAST PLUM CREEK

West Plum Creek

Jarre Creek

ATCHISON TOPEKA AND SANTA FE

DENVER AND RIO GRANDE WESTERN

22 23 24 19 20 27 26 25 30 29 34 35 36 31 32

FoD GsF BtE NsE Bo Lu Se Sa Sd NeE BrB BlE RgE St BwD RlE GoE CrE BrD Lo BsE Sn Lw KwF Fu KtE RnE TrD

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

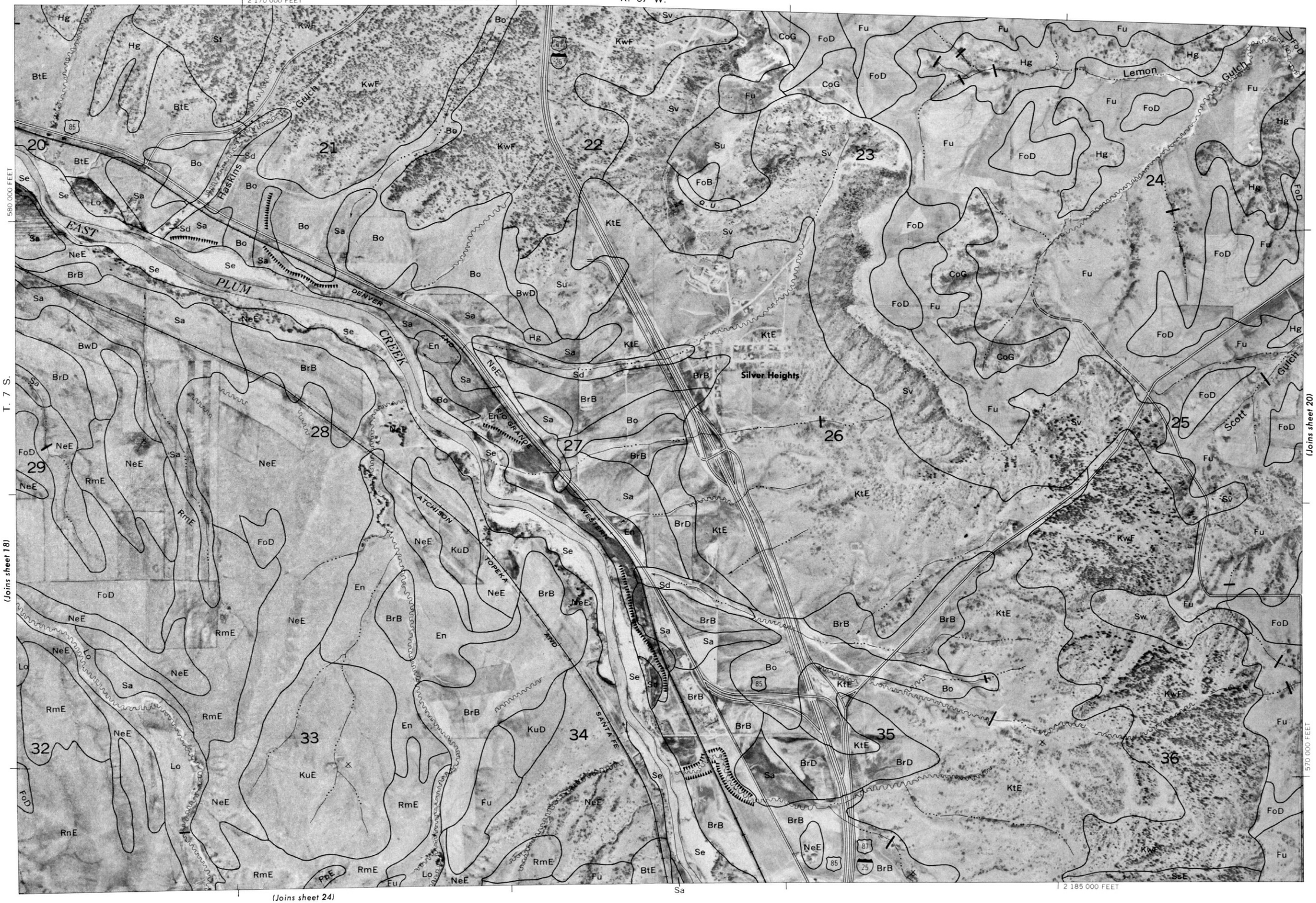
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 18

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 19

CASTLE ROCK AREA, COLORADO NO. 19

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.



N

R. 66 W.

(Joins sheet 15)

2 210 000 FEET

580 000 FEET

T. 7 S.

(Joins sheet 21)

570 000 FEET

2 190 000 FEET

(Joins sheet 25)

1 Mile

5000 Feet

Scale 1:20000
(Joins sheet 19)

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

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CASTLE ROCK AREA, COLORADO NO. 20

CASTLE ROCK AREA, COLORADO NO. 21

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

N

R. 66 W. | R. 65 W.

(Joins sheet 16)

2 215 000 FEET

580 000 FEET

T. 7 S.

(Joins sheet 20)

(Joins sheet 26)

2 235 000 FEET

570 000 FEET

ELBERT COUNTY

1 Mile

5000 Feet

Scale 1:20000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000 5000

N

1 Mile

5000 Feet

Scale 1:20000

0 0

¼ 1000

½ 2000

¾ 4000

1 5000

555 000 FEET

2 120 000 FEET

R. 68 W.

(Joins sheet 17)

2 140 000 FEET

565 000 FEET

T. 8 S.

(Joins sheet 23)

(Joins sheet 27)

(Joins inset,sheet 6)

R. 69 W. 2 118 000 FEET

582 000 FEET

580 000 FEET

PIKE NATIONAL FOREST BOUNDARY

T. 7 S.

(Joins sheet 17)

2 116 000-FEET

PIKE NATL FOR BDY

2 000 FOOT GRID TICKS

Miller Gulch

Creek

Garber Cr

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

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CASTLE ROCK AREA, COLORADO NO. 23

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

2 145 000 FEET

(Joins sheet 18)

R. 68 W. | R. 67 W.

565 000 FEET

T. 8 S.

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 28)

555 000 FEET

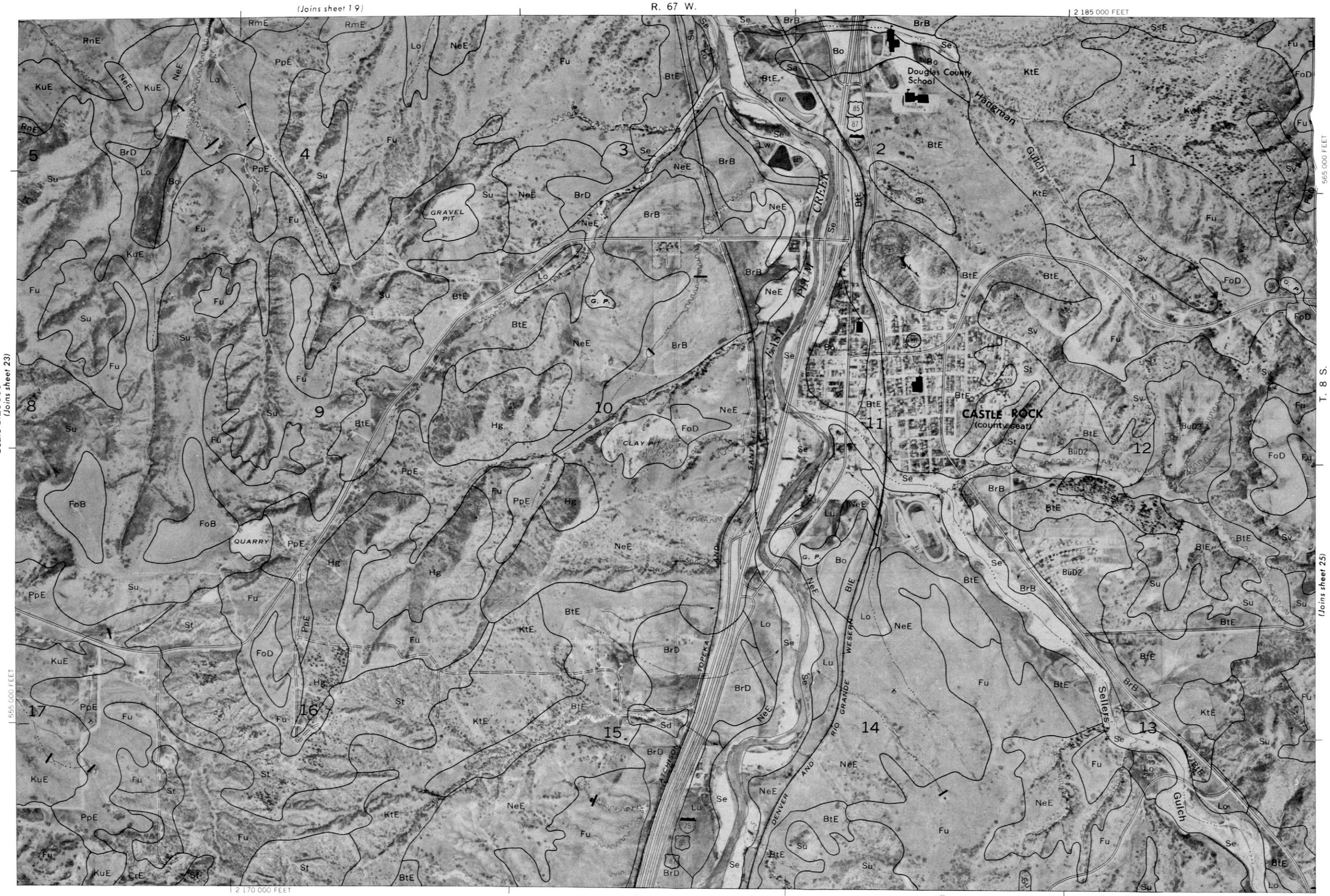
2 165 000 FEET

N

Scale 1:20000

1 Mile

5000 Feet



Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 25

25

N

(Joins sheet 20)

R. 66 W.

2 190 000 FEET

565 000 FEET

T. 8 S.

(Joins sheet 24)

(Joins sheet 30)

555 000 FEET

2 210 000 FEET

(Joins sheet 26)

Franktown

Barney Bird Reservoir No. 1

Russelville

McMurdo Gulch

Mitchell Gulch

Willow Creek

Cherry Gulch

Scale 1:20000

1 Mile

5000 Feet

CASTLE ROCK AREA, COLORADO NO. 25

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

N

R. 66 W. | R. 65 W.

(Joins sheet 21)

2 235 000 FEET

565 000 FEET

555 000 FEET

2 215 000 FEET

(Joins sheet 31)

1 Mile

5000 Feet

Scale 1:20000
(Joins sheet 25)

T. 8 S.

ELBERT COUNTY

CASTLE ROCK AREA, COLORADO NO. 26

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA COLORADO — SHEET NUMBER 27

27

N

(Joins sheet 22)

R. 68 W.

2 120 000 FEET

550 000 FEET

Middle Gerber Creek

Gerber Creek

Shamballah — Ashrama

Gott Mountain

PIKE NATIONAL FOREST BOUNDARY

T. 8 S.

19 20 21 30 29 28 31 32 33

(Joins sheet 28)

540 000 FEET

PIKE NATIONAL FOREST BOUNDARY

(Joins inset A, sheet 40)

2 140 000 FEET

1 Mile 5000 Feet

Scale 1:20000

CASTLE ROCK AREA, COLORADO NO. 27

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(28)

N

(Joins sheet 23)

R. 68 W. | R. 67 W.

2 165 000 FEET

550 000 FEET

T. 8 S.

1 Mile

5000 Feet

0 0

Scale 1:20000

(Joins sheet 27)

¼ 1000 2000

½ 3000

¾ 4000

1 5000

540 000 FEET

2 145 000 FEET

(Joins sheet 29)

(Joins sheet 32)

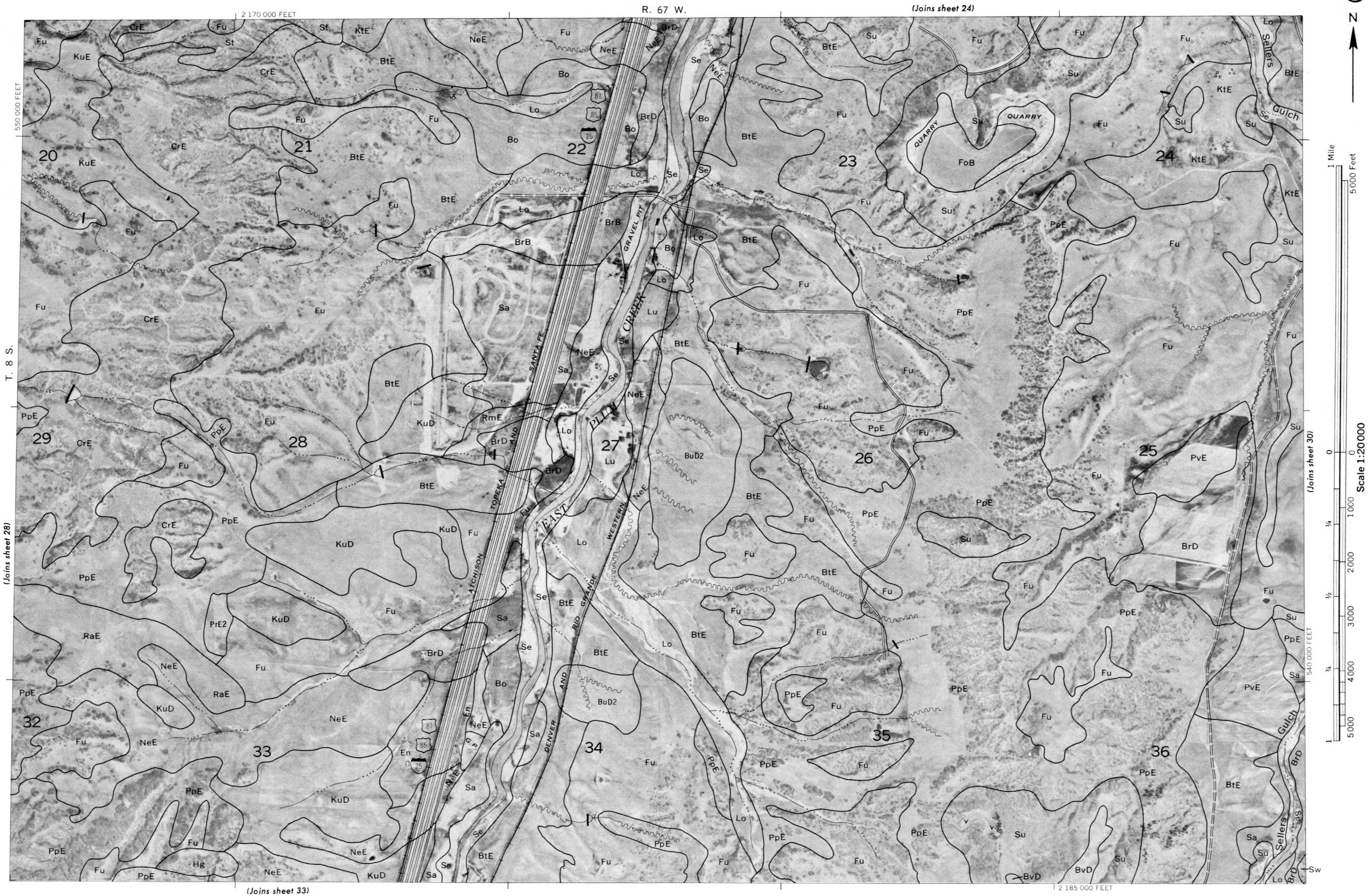
Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

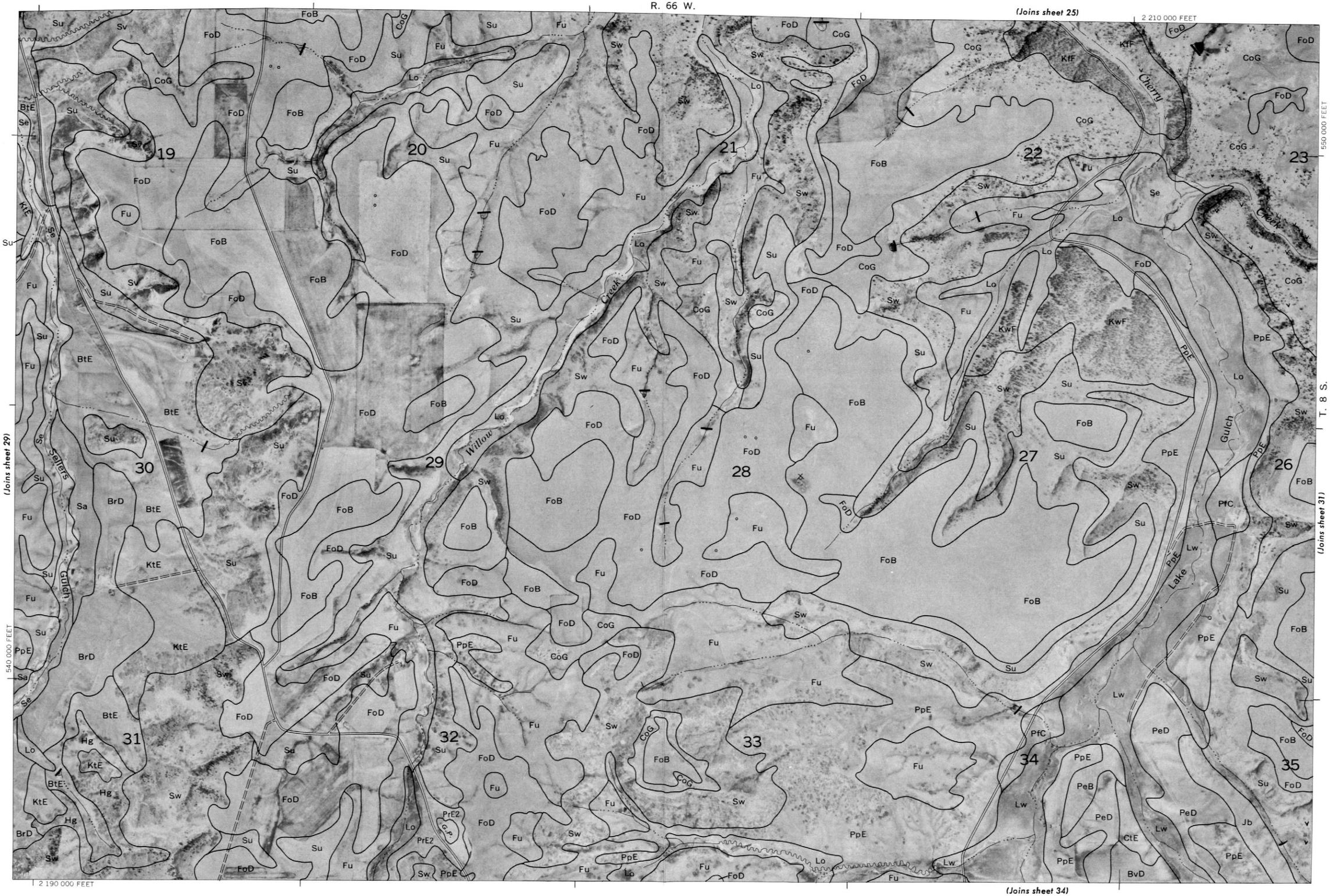
CASTLE ROCK AREA, COLORADO NO. 28

29



CASTLE ROCK AREA, COLORADO NO. 29

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 31

31

CASTLE ROCK AREA, COLORADO NO. 31

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

R. 66 W. | R. 65 W.

2 215 000 FEET

550 000 FEET

(Joins sheet 26)

(Joins sheet 30)

(Joins sheet 35)

2 235 000 FEET

540 000 FEET

T. 8 S.

N

ELBERT COUNTY

Scale 1:20000

1 Mile

5000 Feet

Wildcat Canyon

Russellville Gulch

Cherry Creek

N

(Joins sheet 28)

R. 68 W. | R. 67 W.

2 165 000 FEET

535 000 FEET

T. 9 S.

(Joins inset A, sheet 40)

1 Mile

5000 Feet

Scale 1:20000

0 0

¼ 1 000

½ 2000

¾ 3000

1 4000

5000

Spring Gulch

Dawson Butte

West Plum Creek

Bear Creek

Hog John Gulch

GLEN GROVE CEMETERY

105

1 2 3 4 5 6 7 8 10 11 12 13 14 15 17 18

525 000 FEET

2 145 000 FEET

(Joins sheet 33)

(Joins sheet 36)

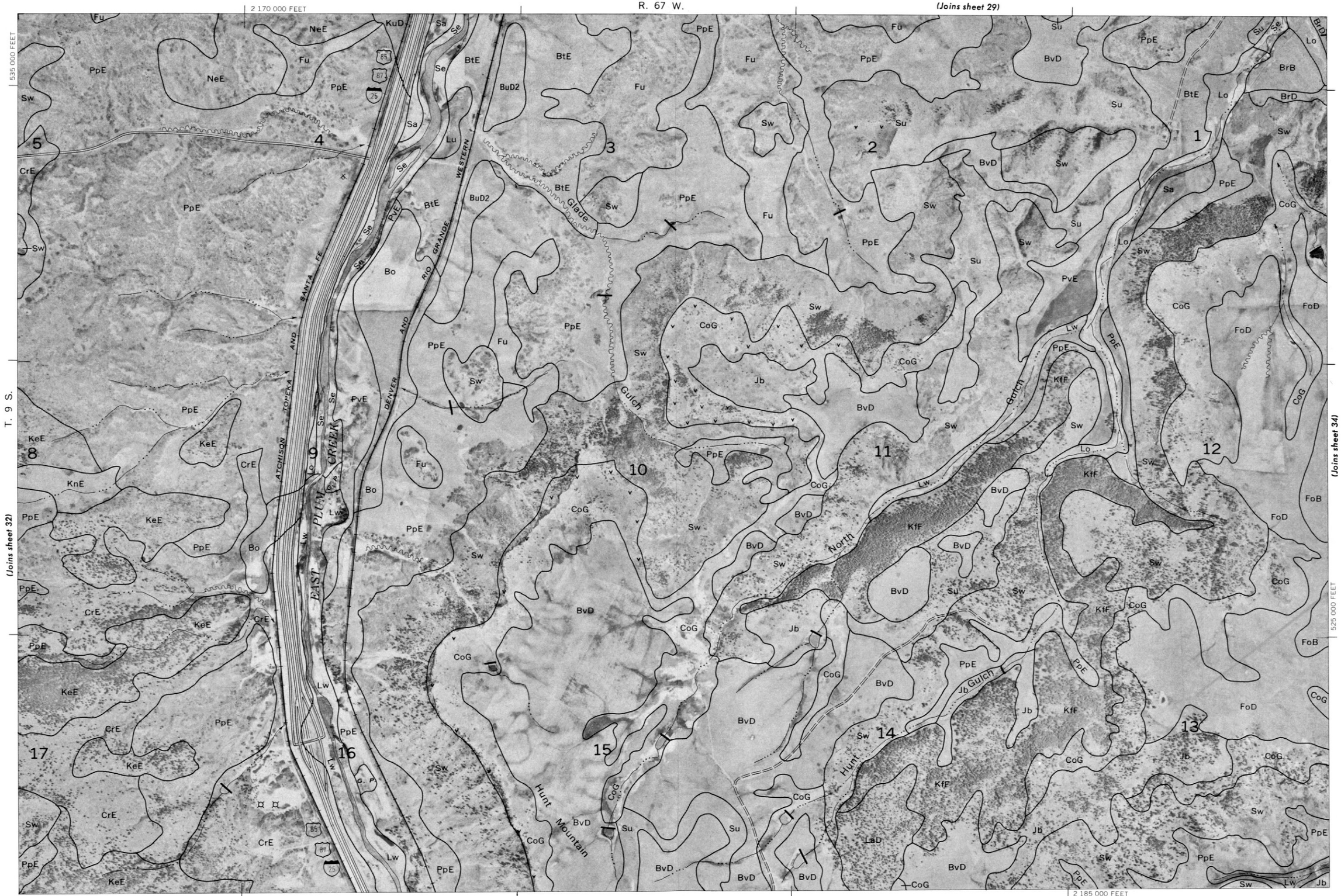
Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 33

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.



N

R. 66 W.

(Joins sheet 30)

2 210 000 FEET

535 000 FEET

T. 9 S.

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 33)

525 000 FEET

2 190 000 FEET

(Joins sheet 35)

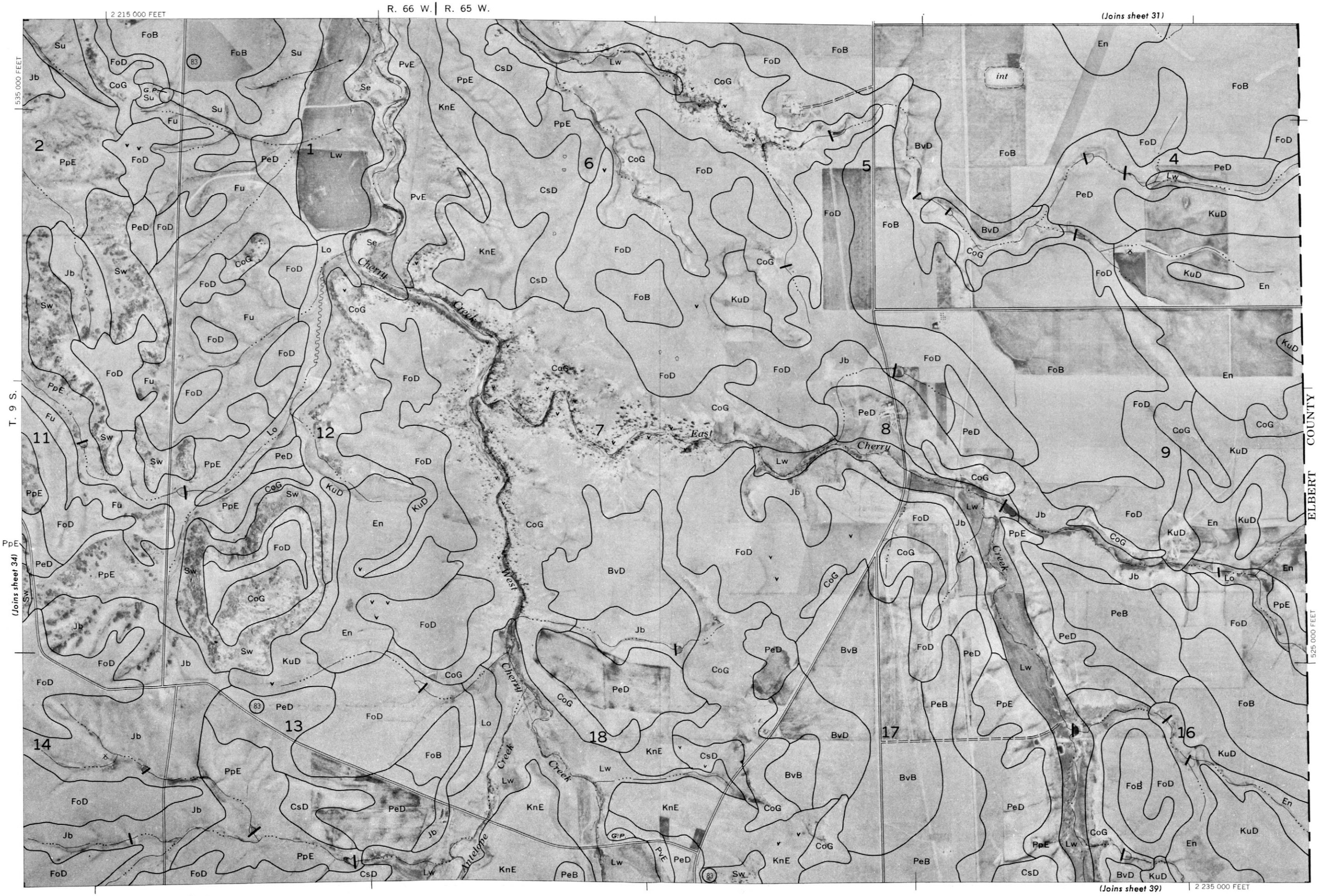
(Joins sheet 38)

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 35



N

Scale 1:20000 (Joins inset B, sheet 40)

1 Mile 5000 Feet

(Joins sheet 32)

R. 68 W. | R. 67 W.

2 165 000 FEET

520 000 FEET

T. 9 S.

(Joins sheet 37)

505 000 FEET

2 145 000 FEET

PIKE NATIONAL FOREST BOUNDARY

(Joins sheet 40)

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 37

CASTLE ROCK AREA, COLORADO NO. 37

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station. Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum. Land division corners are approximately positioned on this map.

37

N

2 170 000 FEET

520 000 FEET

R. 67 W.

(Joins sheet 33)

T. 9 S.

(Joins sheet 36)

(Joins sheet 41)

(Joins sheet 38)

2 185 000 FEET

505 000 FEET

Scale 1:20000

1 Mile

5000 Feet

Larkspur

Raspberry Butte

Monkey Face

Larkspur Butte

Upper Lake Gulch

DENVER AND RIO GRANDE WESTERN

SANTA FE

ATCHISON TOPEKA AND

EAST PLUM CREEK

PLUM CREEK

Carpenter Creek

G.P.

20 21 22 23 24 25 26 27 28 29 32 33 34 35 36

N

R. 66 W.

(Joins sheet 34)

2 210 000 FEET

520 000 FEET

T. 9 S.

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 37)

(Joins sheet 39)

505 000 FEET

2 190 000 FEET

(Joins sheet 42)

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.

CASTLE ROCK AREA, COLORADO NO. 38

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 39

39

N

R. 66 W. | R. 65 W.

(Joins sheet 35)

2 215 000 FEET

520 000 FEET

T. 9 S.

(Joins sheet 38)

(Joins sheet 43)

2 235 000 FEET

505 000 FEET

ELBERT COUNTY

Cherry Valley School

Antelope Creek

Cherry Creek

West Cherry Creek

East Cherry Creek

1 Mile

5000 Feet

Scale 1:20000

CASTLE ROCK AREA, COLORADO NO. 39

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Colorado Agricultural Experiment Station.
Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

Colole. 192 Atum.

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 40

N

1 Mile 5000 Feet

Scale 1:20000

INSET A

(Joins sheet 27) R. 68 W. 2 140 000 FEET

535 000 FEET

T. 9 S.

PIKE NATIONAL FOREST BOUNDARY

GYPSUM BED

Dry Gulch

Sprintu Creek

(Joins sheet 32)

525 000 FEET

2 135 000 FEET

INSET B

PNFB R. 68 W. 2 142 000

514 000 FEET

513 000 FEET

2 141 000

Bear Creek

(Joins sheet 36)

T. 9 S.

PIKE NATL FOR BDY

1 000-FOOT GRID TICKS

(Joins sheet 36) R. 67 W. 2 165 000 FEET

500 000 FEET

T. 10 S.

PIKE NATIONAL FOREST BOUNDARY

Plum Creek

East John Gulch

Hog

(Joins sheet 41)

490 000 FEET

2 160 000 FEET

(Joins sheet 44)

Land division corners are approximately positioned on this map.

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2 170 000 FEET

R. 67 W.

(Joins sheet 37)

500 000 FEET

T. 10 S.

(Joins sheet 40)

(Joins sheet 45)

2 185 000 FEET

490 000 FEET

(Joins sheet 42)

(Joins sheet 43)

N

Scale 1:20000

1 Mile

5000 Feet

Carpenter Creek

Plum Creek

East Plum Creek

Lost Creek

Cook Creek

Denver and Rio Grande Western

Atchison Topeka and Santa Fe

Corner Mountain

Rattlesnake Butte

Greenland

25 87 85

CrE KnE PeD PeB PpE PvE PfC CsD KfF KeE Lw Lo Ka Sw Su Jb RaE PrE2

N

(Joins sheet 38)

R. 66 W.

2 210 000 FEET

T. 10 S.

500 000 FEET

Nemrick Butte

Haskel Creek

Antelope Creek

Lincoln Mountain

(Joins sheet 41)

(Joins sheet 43)

(Joins sheet 46)

2 190 000 FEET

490 000 FEET

Scale 1:20000

1 Mile

5000 Feet

Land division corners are approximately positioned on this map.

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CASTLE ROCK AREA, COLORADO NO. 42

2 215 000 FEET

R. 66 W. | R. 65 W.

(Joins sheet 39)

500 000 FEET

T. 10 S.

(Joins sheet 42)

(Joins sheet 47)

2 235 000 FEET

490 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

ELBERT COUNTY

Cherry Creek

Crowfoot Creek

West Cherry Creek

East Cherry Creek

N

1 Mile
5000 Feet
0
Scale 1:20000
0
1000
2000
3000
4000
5000

¼
½
¾

475 000 FEET

2 145 000 FEET

(Joins sheet 40)

R. 67 W.

2 165 000 FEET

485 000 FEET

105

KeE
TcE
GaE
19
20
JuF
TcE
GaE
RfE
105
TcE
LvE
Creek
Cook
Ka
PvE
TcE
T. 10 S.
KfF
29
30
JuF
GaE
TcE
105
(Joins sheet 45)
G. P.
GaE
TcE
31
32
JuF
TcE

PIKE NATIONAL FOREST BOUNDARY

EL PASO COUNTY

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone. 1927 North American datum.

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CASTLE ROCK AREA, COLORADO NO. 44

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 45

CASTLE ROCK AREA, COLORADO NO. 45

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Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

45

N

2 170 000 FEET

485 000 FEET

R. 67 W.

(Joins sheet 41)

T. 10 S.

(Joins sheet 44)

(Joins sheet 46)

475 000 FEET

2 190 000 FEET

EL PASO COUNTY

Eagle Mountain

Spruce Mountain

True Mountain

Bald Mountain

Cook Creek

Carpenter Creek

ATCHISON TOPEKA AND SANTA FE

DENVER AND RIO GRANDE WESTERN

Scale 1:20000

1 Mile

5000 Feet

(46)

N

(Joins sheet 42)

R. 66 W.

2 210 000 FEET

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 45)

0 1000 2000 3000 4000 5000

¼ ½ ¾ 1

19 20 21 22 23

29 28 27 26

30 31 32 33 34 35

Best Butte

Cherry Creek

Elk Creek

West Creek

T. 10 S.

485 000 FEET

475 000 FEET

(Joins sheet 47)

2 195 000 FEET

EL PASO COUNTY

Land division corners are approximately positioned on this map.

Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado Coordinate system, east zone, 1927 North American datum.

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CASTLE ROCK AREA, COLORADO NO. 46

CASTLE ROCK AREA, COLORADO — SHEET NUMBER 47

47

N

2 215 000 FEET

R. 66 W. | R. 65 W.

(Joins sheet 43)

485 000 FEET

T. 10 S.

(Joins sheet 46)

475 000 FEET

2 235 000 FEET

EL PASO COUNTY

ELBERT COUNTY

Bucks Mountain

Crowfoot Creek

Cherry Creek

East Cherry Gulch

Iron Gulch

Elk Creek

1 Mile

5000 Feet

Scale 1:20000

CASTLE ROCK AREA, COLORADO NO. 47

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Photobase from 1967 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Colorado coordinate system, east zone, 1927 North American datum.

Land division corners are approximately positioned on this map.